SRMC-CWDA-2024-00059
Revision 0

Proposal to Cease Waste Removal Activities in Tank 9 and Enter Sampling and Analysis Phase

L. B. Romanowski

Waste Disposal Authority

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Presentation Outline

- Meeting Objective
- Summary/Recommendations
- Waste Removal History and Results
- Additional Cleaning Considerations
- Path Forward
- Request for Department of Energy (DOE), South Carolina Department of Environmental Services (SCDES), and Environmental Protection Agency (EPA) Concurrence
- Background

.

Acronyms

A-P	Annulus to Primary
ALT	Alternate
BSL	Bulk Salt Level
CGCP	Consolidated General Closure Plan
CM	Closure Module
CSMP	Commercial Submersible Mixing Pump
DOE	U.S. Department of Energy
DSS	Dissolved Salt Solution
DWPF	Defense Waste Processing Facility
ECR	Effective Cleaning Radius
EPA	U.S. Environmental Protection Agency
FFA	Federal Facility Agreement
HDB	H Area Diversion Box
HIHTL	Hose-in-Hose Transfer Line
HHW	High Heat Waste
HPP	H Area Pump Pit
HTF	H Tank Farm
LL	Liquid Level
LWTRSAPP	Liquid Waste Tank Residuals Sampling and Analysis Program Plan
LVMJ	Low Volume Mixing Jet
MCL	Maximum Contaminant Level
PCWR	Preliminary Cease Waste Removal
PUREX	Plutonium-Uranium Extraction Process
S&A	Sampling and Analysis
SCDHEC	South Carolina Department of Health and Environmental Control[1]
SCDES	South Carolina Department of Environmental Services[1]
SMP	Submersible Mixing Pump
SPF	Saltstone Production Facility
STD	Standard
STP	Submersible Transfer Pump
SWPF	Salt Waste Processing Facility
TCCR	Tank Closure Cesium Removal

[1]South Carolina Department of Environmental Services (SCDES) was known as South Carolina Department of Health and Environmental Control (SCDHEC) prior to July 1, 2024. Throughout this presentation figures and text reproduced from existing documents may still reflect SCDHEC nomenclature.

Meeting Objective

Obtain mutual agreement among DOE, SCDES, and EPA to:

1. **Suspend waste removal activities in Tank 9; and**
2. **Enter the Sampling and Analysis phase in Tank 9 consistent with the *Consolidated General Closure Plan for F-Area and H-Area Waste Tank Systems* (CGCP) and *Liquid Waste Tank Residuals Sampling and Analysis Program Plan* (LWTRSAPP)**

Tank 9 Primary

Summary

- 99% of the waste volume in Tank 9 has been removed
- A qualitative assessment indicates that the CGCP performance objectives will not be challenged
- Tank 9 is not a significant contributor to doses in H Tank Farm (HTF) Performance Assessment and additional waste removal would have minimal impact on estimated doses/performance objectives
- Additional waste removal activities in Tank 9 would have a negative impact on other Liquid Waste risk reduction activities
- A quantitative assessment utilizing final residual waste volumes and results of sampling and analysis will be included in the Closure Module covering Tank 9
- A formal discussion on the “practicability” of additional waste removal will be included in the Closure Module covering Tank 9

Performance Objectives

Based on the characteristics and estimated volume of the waste remaining in Tank 9, performance objectives are expected to be met.

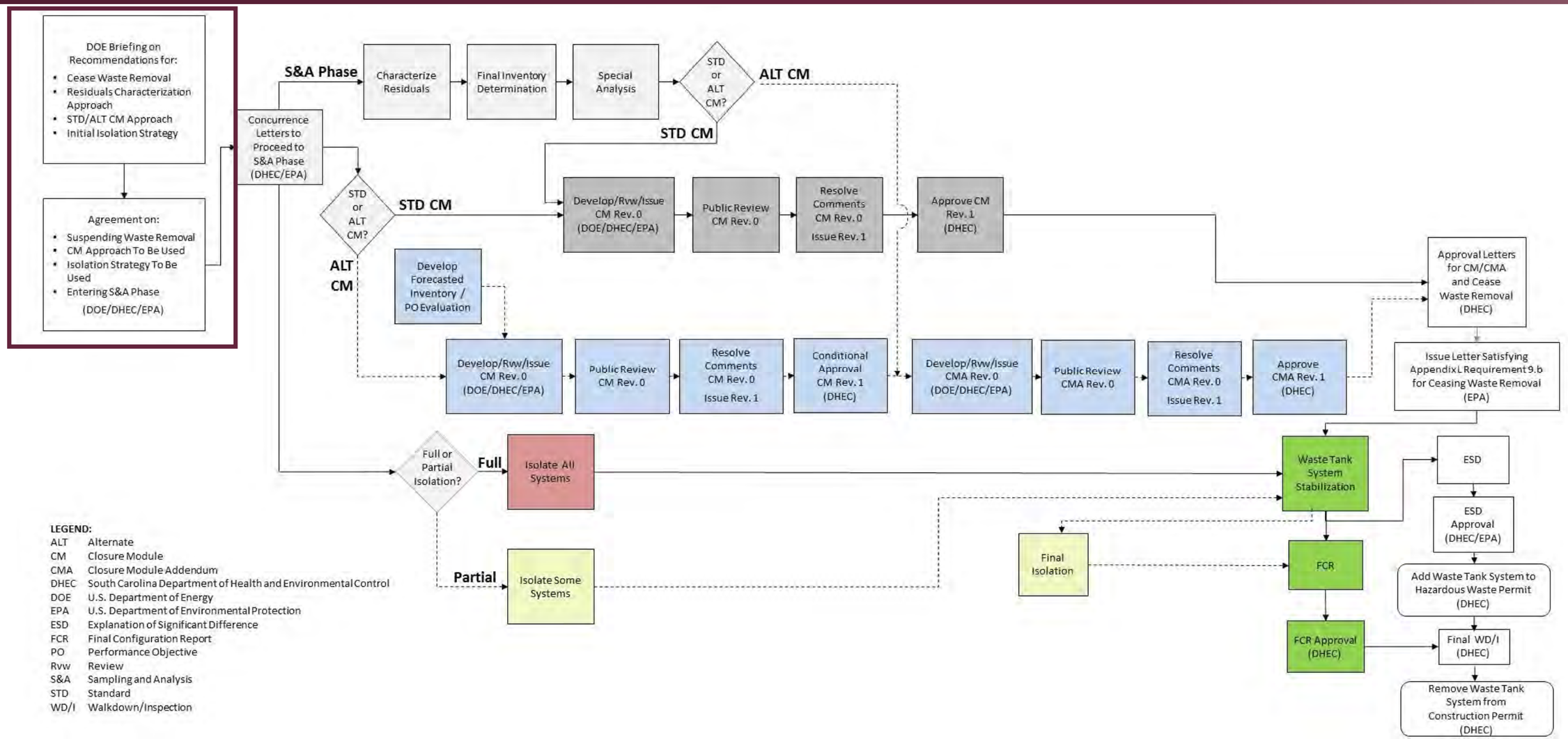
- Anticipate that concentration values in the groundwater for HTF will be below the Maximum Contaminant Level (MCL) values for all the non-radiological inorganic constituents listed in Table 9.2-1 of the CGCP
- Anticipate that concentration values in the groundwater for HTF will be below the MCL values for radionuclides consistent with the State Primary Drinking Water Regulations including:
  - 4 mrem/yr dose for beta- and gamma-emitting nuclides
  - 15 picocuries per liter (pCi/L) for alpha-emitting nuclides (including Ra-226 but excluding radon and uranium)
  - 5 pCi/L for radium (Ra-226 plus Ra-228)
  - 30 micrograms per liter (µg/L) of uranium

Radiation Dose Perspective

- **Anticipate that the peak dose from Tank 9 will be <3 mrem/year during both the 1,000 year and 10,000-year periods after HTF closure***
  - Tank 9 is not a significant contributor to the peak dose in the HTF Performance Assessment
    - *Tank 9 peak dose not anticipated to coincide with timing and location of overall peak dose within HTF*
- **To put this radiological dose into perspective**
  - Per NCRP-160, the average annual dose to a person in the United States is approximately 620 mrem primarily from:
    - *Approximately 310 mrem from naturally occurring background*
    - *Approximately 300 mrem from medical procedures*

* Based on a preliminary estimate of the volume. Final inventories and dose impacts will be included in the Closure Module.

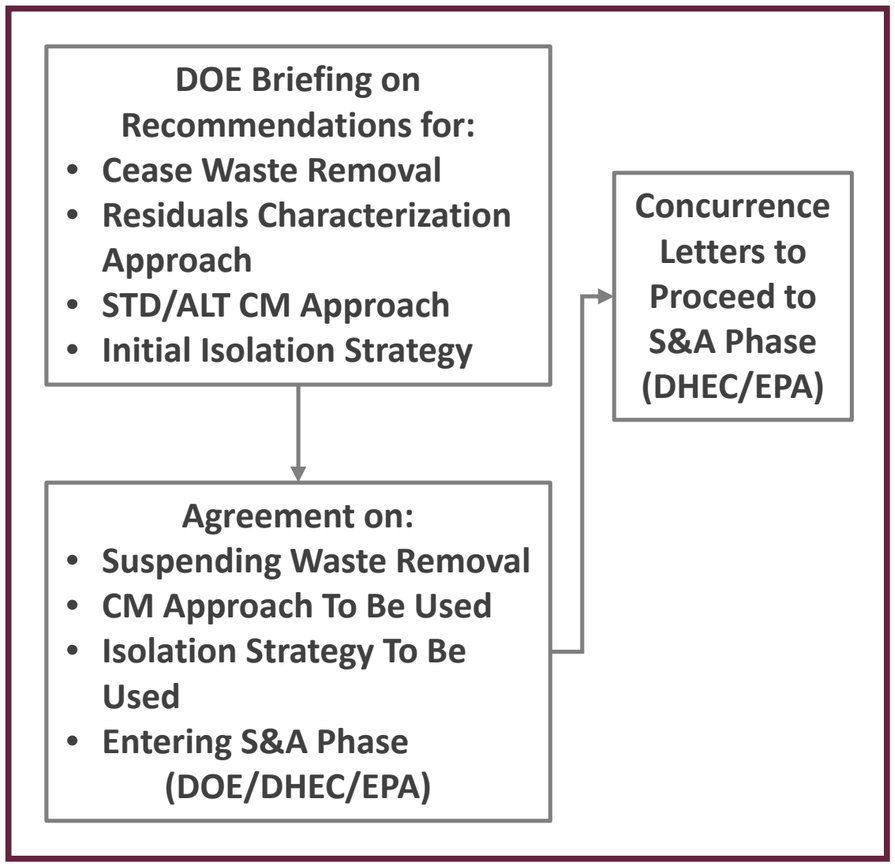
Pathway to Closure



Closure Module Approval and Waste Tank System Removal from Service Process (CGCP Figure 11.4-1)

[SRR-CWDA-2017-00015]

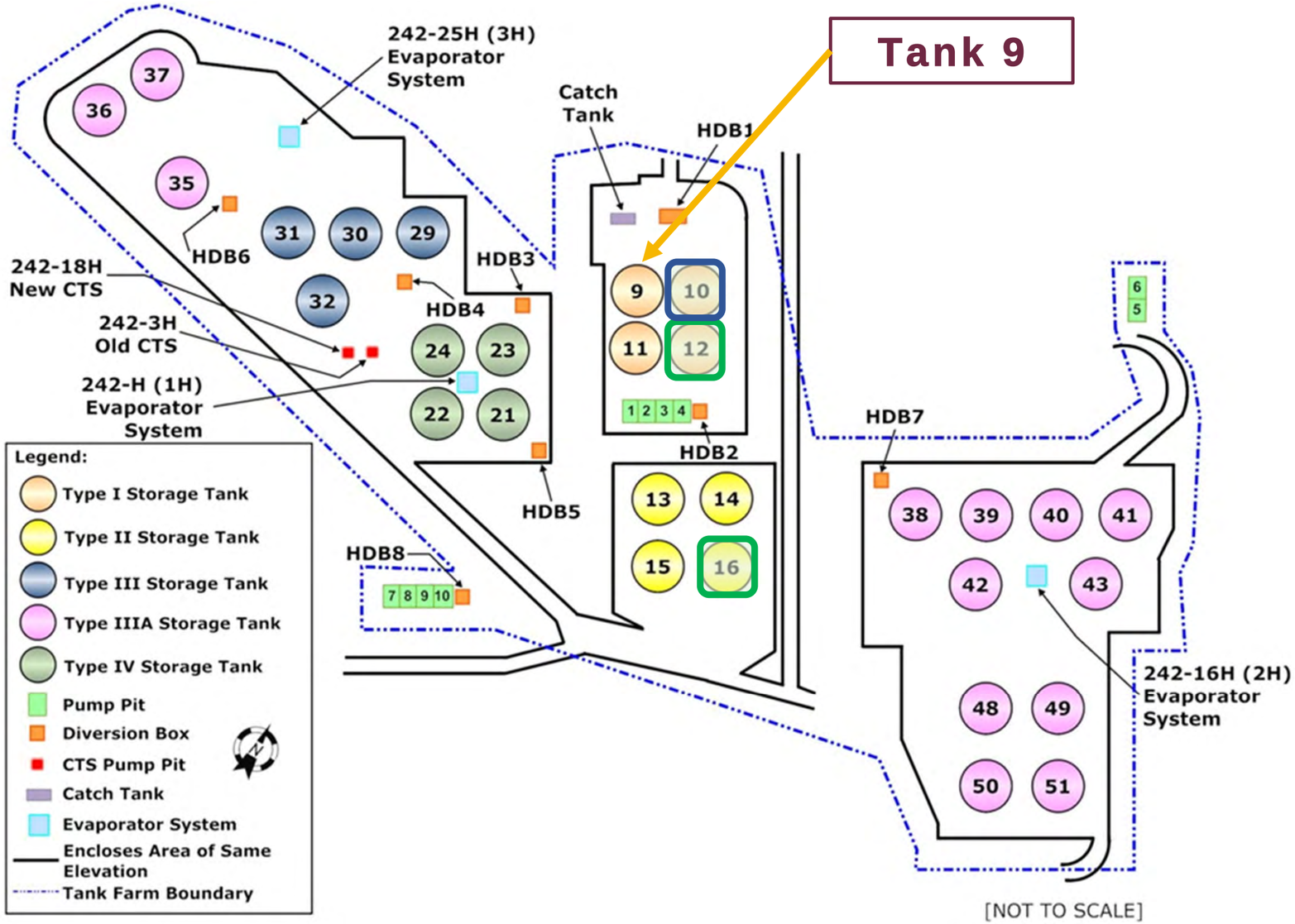
Recommendations



[SRR-CWDA-2017-00015]

1. **Suspending waste removal activities in Tank 9 and enter the Sampling and Analysis phase.**
   - Sampling and analysis to be performed per the LWTRSAPP
2. **DOE will draft a Closure Module using the *Standard Closure Module* Approach**
   - Current plans to issue one Closure Module covering Tanks 9, 10 and 11.
3. **The Closure Module will include appropriate isolation and stabilization provisions using the *Partial Isolation* approach**

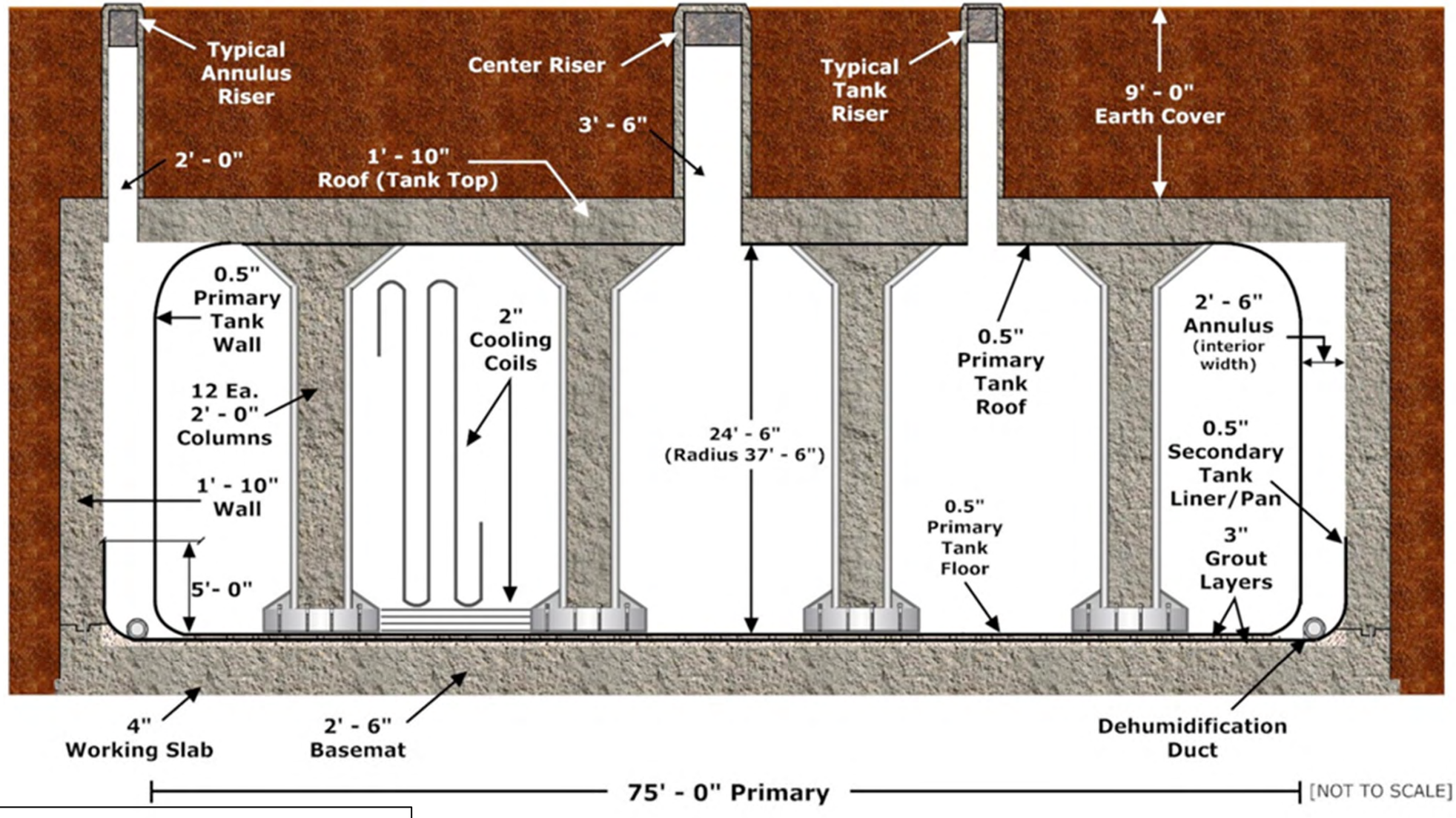
H-Tank Farm Layout



Closed Tank(s)

PCWR Complete Tank(s)

Typical Type I Tank



Nominal working capacity: 750,000 gallons
For a Type I Tank, 1” of waste equals 2,710 gallons

[SRR-CWDA-2017-00015]

Tank 9 Historical Timeline

1955

Tank 9 Placed into Service as a Receipt Tank for PUREX HHW

1958

Liquid Level Reaches Historic High of 273”

1965-1966

Waste Removal Phase 1 Tank Prepared to be an Evaporator Concentrate Receipt Tank

- High-pressure sluicers and multiple transfer pumps used
- Estimated 1-2” of sludge remaining

1967

Tank 9 Begins Receiving Evaporator Concentrate

1969

Tank Filled and Left Inactive

- Estimated to contain 203.5” of waste

2019-2022

Waste Removal Phase 2 Salt Dissolution To Support TCCR Processing

- LVMJ used
- Five cycles of water addition and DSS transfer

2023-2024

Waste Removal Phase 3 Tank Prepared for Closure

- Two CSMPs used initially, third added for later campaigns
- Seven campaigns in total using 1,090Kgal of water
- Two batches of annulus cleaning

CSMP – Commercial Submersible Mixing Pump
DSS – Dissolved Salt Solution
HHW – High Heat Waste
LVMJ – Low Volume Mixing Jet
PUREX – Plutonium-Uranium Extraction Process
TCCR – Tank Closure Cesium Removal

Waste Removal Phase 3 Summary

July 2022 – November 2023: Tank 9 equipment updated and replaced to improve the efficiency of salt dissolution

- LVMJ and a downcomer removed
- CSMPs installed
- Submersible Transfer pump (STP) replaced
- A new Hose-in-Hose Transfer Line (HIHTL) established to allow transfers from Tank 9 to Tank 11

Campaign	Date	Water Added (Kgals)	DSS Transferred (Kgals)	Riser 1 CSMP Elevation (inches)	Riser 4 CSMP Elevation (inches)	Riser 6 CSMP Elevation (inches)	STP Elevation (inches)
1	11/2023 - 12/2023	59	136	181	181	-	204.5 – 144.5
2	12/2023 - 1/2024	135	163	161	161	-	108.5
3	1/2024 - 2/2024	153	171	131	131	-	84.5
4	3/2024 - 4/2024	170	163	121	121	-	84.5
5	4/2024 -5/2024	153	348	121	121	141	48.5
6	6/2024 - 7/2024	277	417	51 – 11	51 – 11	61 - 11	3.5
Annulus Cleaning	7/2024	10	-	-	-	-	-
7	7/2024 - 8/2024	133	143	11	11	11	1
Total	-	1,090	1,541	-	-	-	-

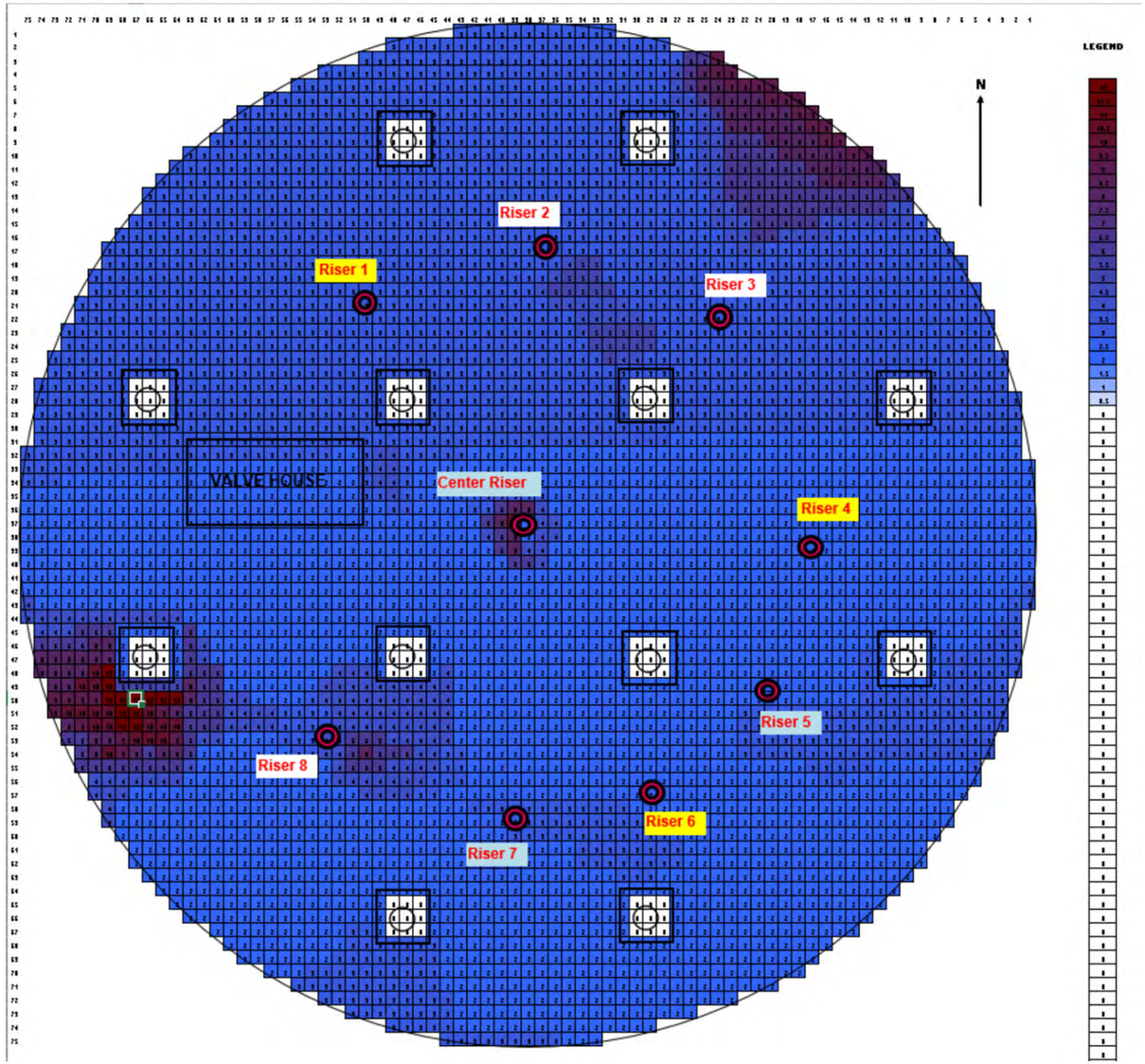
Overall Cleaning Results

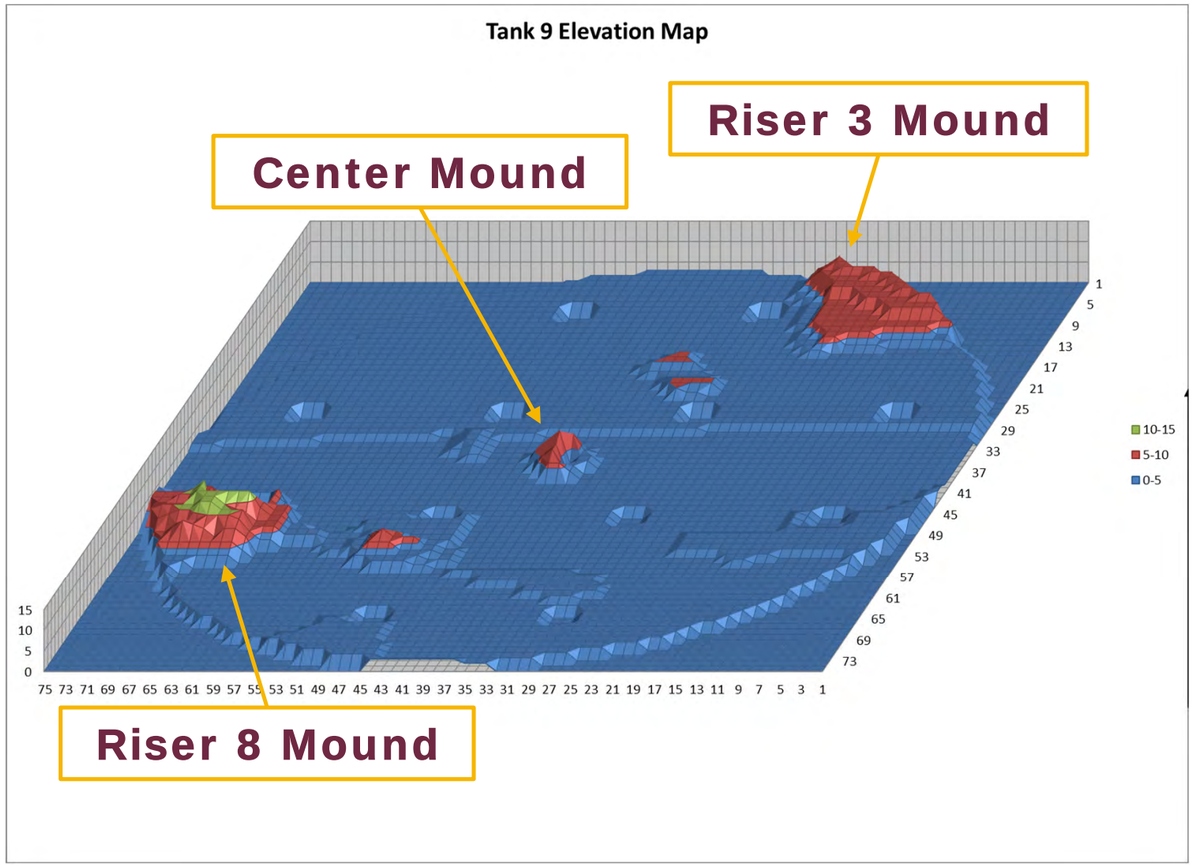
Maximum Waste Volume (gal)	740,000
Maximum Solids Volume (gal)	46,000
Maximum Salt Volume (gal)	550,000
Total Salt Remaining (gal)	0[1]
Total Solids Remaining (gal)	<7,500[2]
Total Waste Remaining (gal)	<7,500[3]

[1] Based on a preliminary estimate of the salt remaining in the annulus. Final volume determination will be included in the Closure Module.
[2] Based on a preliminary estimate of the solids remaining in the primary. Final volume determination will be included in the Closure Module.
[3] Based on a preliminary estimate of the primary plus annulus. Final volume determination will be included in the Closure Module.

Total Percent Waste Removed 99%

Current Status of Tank 9



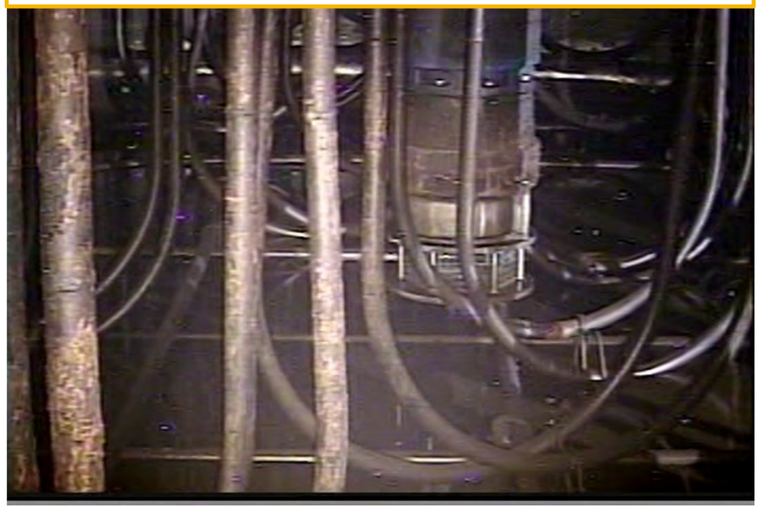


[U-ESR-H-00241 Rev. 1]

Tank 9 Prior to Waste Removal Phase 2

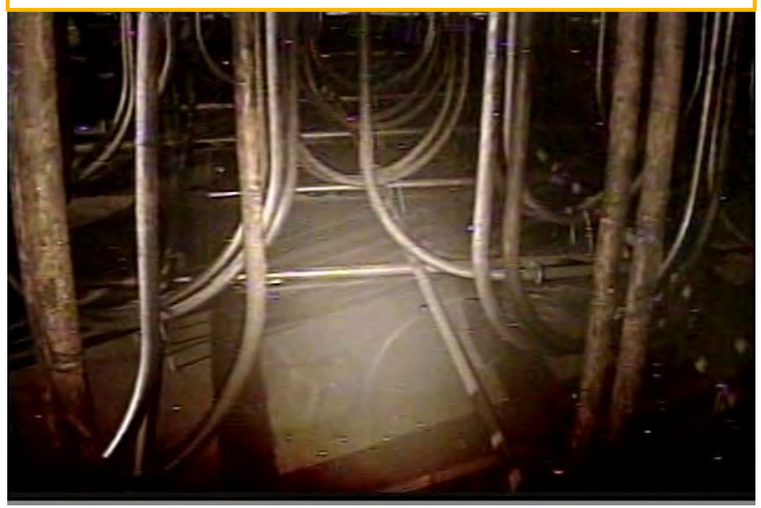
Current Status of Tank 9

Riser 4 CSMP from Center Riser



Riser 6 CSMP from Riser 5

Center Riser to West



Riser 7 to Southern Wall

Center Riser to Southeast

Center Riser to East

Current Status of Tank 9

Center Mound From Riser 7

Riser 8 Mound from Riser 7

Riser 3 Mound from Center Riser

Center Mound Southern Side

Riser 8 Mound from Center Riser

Riser 3 Mound from Center Riser

Tank 9 Annulus Cleaning

West Riser Before / After

South Riser Before / After

South Riser Before / After

Tank 9 Annulus Inspection

- **Annulus inspection performed utilizing a drone**
  - First use of this technology within the tank closure process
  - 100% inspection of the Tank 9 annulus was possible
- **Inspection of annular pan showed cleaning effectiveness consistent in all areas**
- **No salt accumulations were seen on either the exterior walls of the primary tank or in the annular pan**

Northwest Quadrant

Northeast Quadrant

Southwest Quadrant

Southeast Quadrant

Additional Removal Options

- **Additional mixing campaigns**
  - Each new mixing campaign requires a minimum of approximately 150K gallons of water be added to Tank 9 to allow for mixing pump operation, creating additional new waste
    - *Additional new waste must be handled within the Liquid Waste System which is already challenged by available tank space to support Salt Batch compilation/qualification and Sludge Batch compilation/qualification necessary to feed Salt Waste Processing Facility (SWPF) and the Defense Waste Processing Facility (DWPF), respectively*
    - *Additional new waste must be processed through SWPF then subsequently DWPF or the Saltstone Production Facility (SPF), resulting in additional costs and impacts (i.e., extension) to the Liquid Waste System life-cycle*
  - Each new mixing campaign would divert resources (i.e., funding and personnel) from other Liquid Waste System risk reduction activities
    - *E.g., impact ongoing waste removal activities in Tank 11 which is also located in the water table*
  - Level of additional waste removal uncertain, but even removing the majority of the remaining material, if possible, would have a minimal impact on final performance objective concentrations and doses

Additional Removal Options

- **Chemical Cleaning**
  - Any chemical cleaning campaign would require a minimum of approximately 150K gallons of water/chemicals be added to Tank 9 to allow for mixing pump operation, creating additional new waste
    - *Additional new waste must be handled within the Liquid Waste System which is already challenged by available tank space to support Salt Batch compilation/qualification and Sludge Batch compilation/qualification necessary to feed SWPF and DWPF, respectively*
    - *Additional new waste must be processed through SWPF then subsequently DWPF or SPF, resulting in additional costs and impacts (i.e., extension) to the Liquid Waste System life-cycle*
  - Each chemical cleaning campaign would divert resources (i.e., funding and personnel) from other Liquid Waste System risk reduction activities
    - *E.g., impact ongoing waste removal activities in Tank 11 which is also located in the water table*
  - Level of additional waste removal uncertain, but even removing the majority of the remaining material, if possible, would have a minimal impact on final performance objective concentrations and doses
    - *Low-Temperature Aluminum Dissolution anticipated to have minimal impact due to low Aluminum content expected in Tank 9 solids*
    - *Bulk Oxalic Acid Cleaning would have additional adverse impact of introduction of additional oxalates into the system*

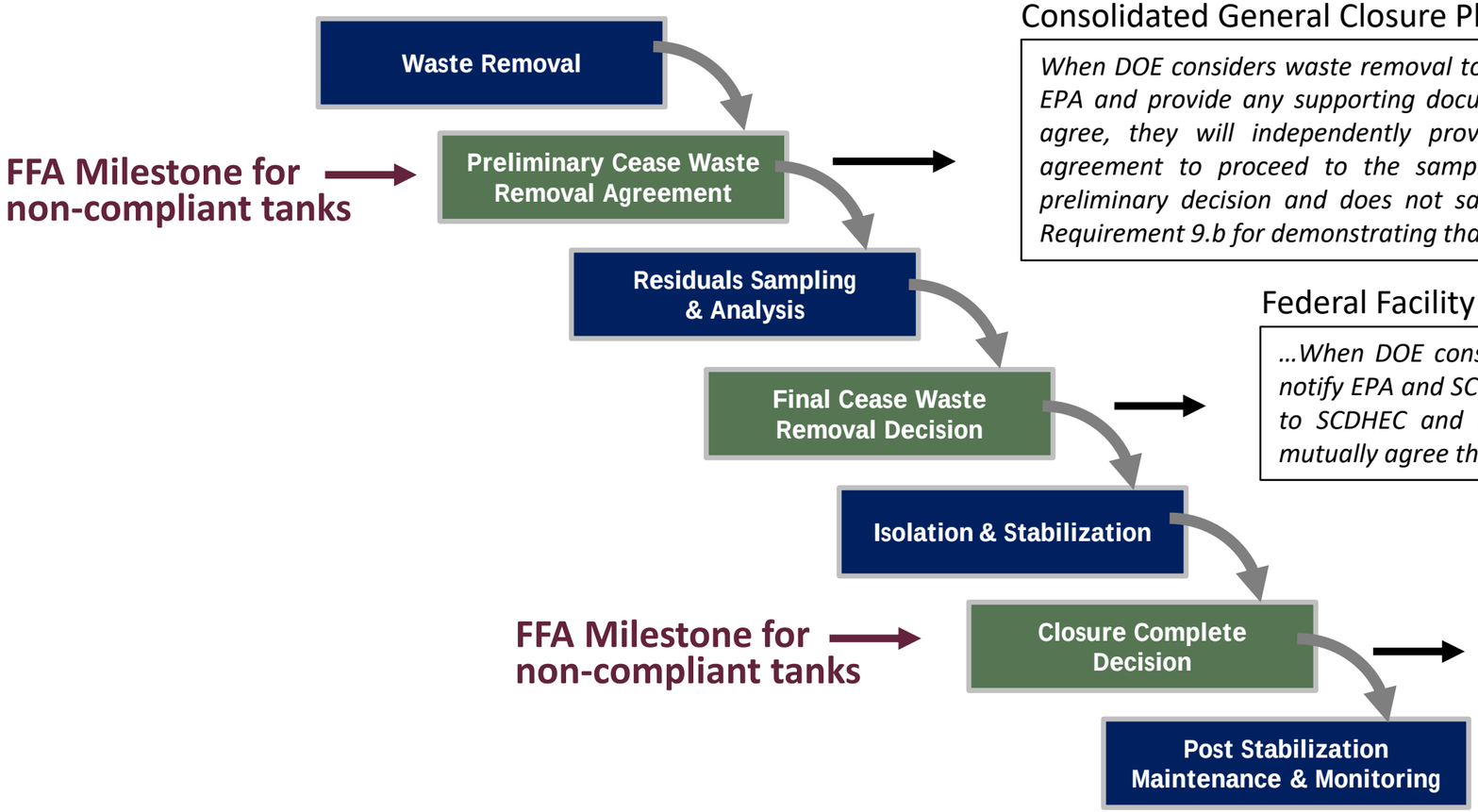
Additional Removal Options

- **Vacuum Technology**
  - Proven Mantis technology that was utilized in Tanks 18 and 19 cannot be deployed due to in-tank obstructions
  - Alternate technology utilizing a smaller robotic platform with vacuum capability would require considerable development
    - *Very limited applicability at the time due to mobility around and over in-tank obstacles and associated tether management*
    - *Any water added to support removal, if required, would result in new waste and have same impact as previously described for additional mixing campaigns and chemical cleaning*
    - *Development/deployment of a new vacuum technology would divert resources (i.e., funding and personnel) from other Liquid Waste System risk reduction activities*
  - Level of additional waste removal uncertain, but even removing the majority of the remaining material, if possible, would have a minimal impact on final performance objective concentrations and doses

Additional Removal Options

- **Additional annulus waste removal**
  - Based on results from annulus inspections it is anticipated a small volume of material may be remaining on the annulus pan floor or in the ventilation duct once free liquid dries up
  - Doses/concentrations associated with any waste remaining within the annulus of Tank 9 are expected to have a negligible contribution to the overall dose associated with the tank

Tank Closure Process



Consolidated General Closure Plan (CGCP)

When DOE considers waste removal to be complete, DOE shall notify SCDHEC and EPA and provide any supporting documentation for review. If EPA and SCDHEC agree, they will independently provide letters of agreement to DOE. This agreement to proceed to the sampling and analysis phase is a non-binding preliminary decision and does not satisfy the requirements of FFA Appendix L, Requirement 9.b for demonstrating that waste removal activities may cease.

Federal Facility Agreement (FFA) Appendix L, Requirement 9.b.

…When DOE considers waste removal to be complete, DOE shall notify EPA and SCDHEC and provide any supporting documentation to SCDHEC and EPA for review. DOE, SCDHEC and EPA shall mutually agree that waste removal activities may cease.

Consolidated General Closure Plan (CGCP)

When the waste tank system has been stabilized with grout, as authorized by the approved Closure Module and cease waste approval letters from SCDHEC and EPA, DOE will have met the FFA commitment for removal from service

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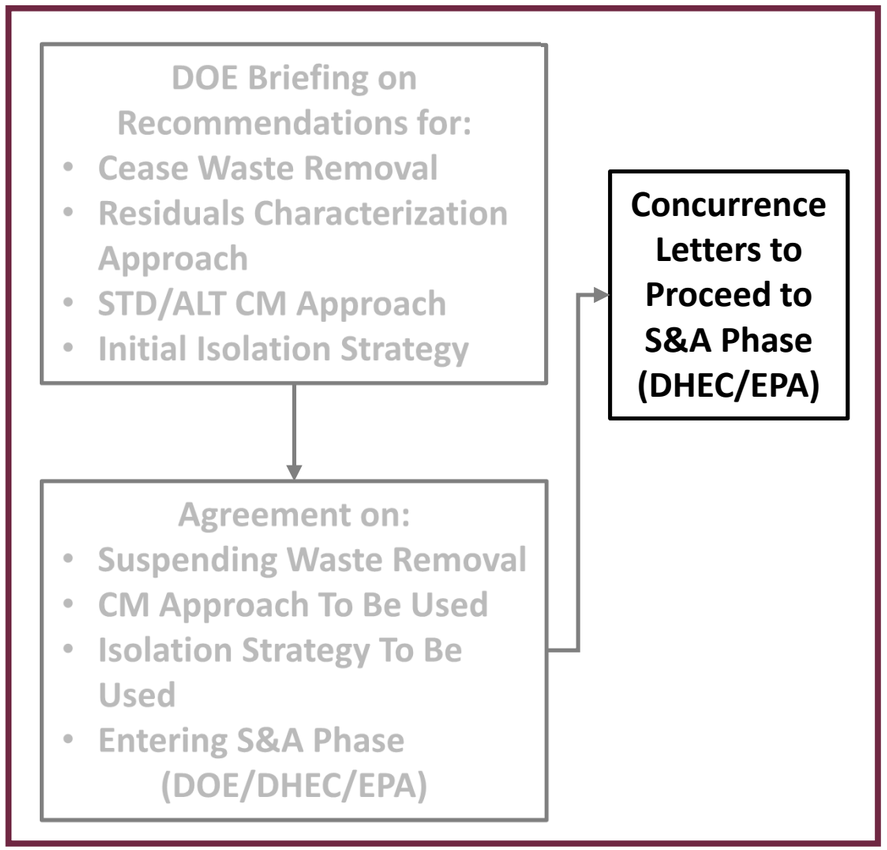
Following waste tank stabilization, the FFA commitment for removal from service (i.e., operational closure) will have been met.

Requested Action



[SRR-CWDA-2017-00015]

The three agencies agree that, based upon the described qualitative assessment, there is reasonable assurance that it is appropriate to suspend waste removal activities and enter the Sampling and Analysis phase of the operational closure process for Tank 9.

Next Steps

- **DOE will forward a letter to SCDES and EPA formally requesting concurrence to proceed to the Sampling and Analysis phase in Tank 9**
  - This presentation will be attached as a primary reference
  - The requested action is a non-binding preliminary decision based on the qualitative information available at this time and presented today
- **DOE and the Liquid Waste Contractor will proceed in developing the regulatory documentation necessary to operationally close Tank 9**
  - DOE will coordinate with SCDES and EPA to establish a schedule for the development, review and approval of the Closure Module consistent with the approach described in the CGCP
    - *Initial focus has been on Tank 10 information, Tank 9 will be included going forward*
    - *Tank 11 information to follow as waste removal progresses within that tank*

Common Goals & Values*

Values

1. Maintain transparency with open communication between regulators, DOE, and the contractor on program progress, and significant emerging issues.
2. Ensure DOE's strategy and plans are subject to stakeholder engagement and input, including SCDHEC permitting processes, and CERCLA, as appropriate.
3. Maximize the amount of curies (especially long-lived radionuclides) vitrified and ready for ultimate disposal out of state.
4. Limit disposal of curies onsite at SRS so that residual radioactivity is as low as reasonably achievable.

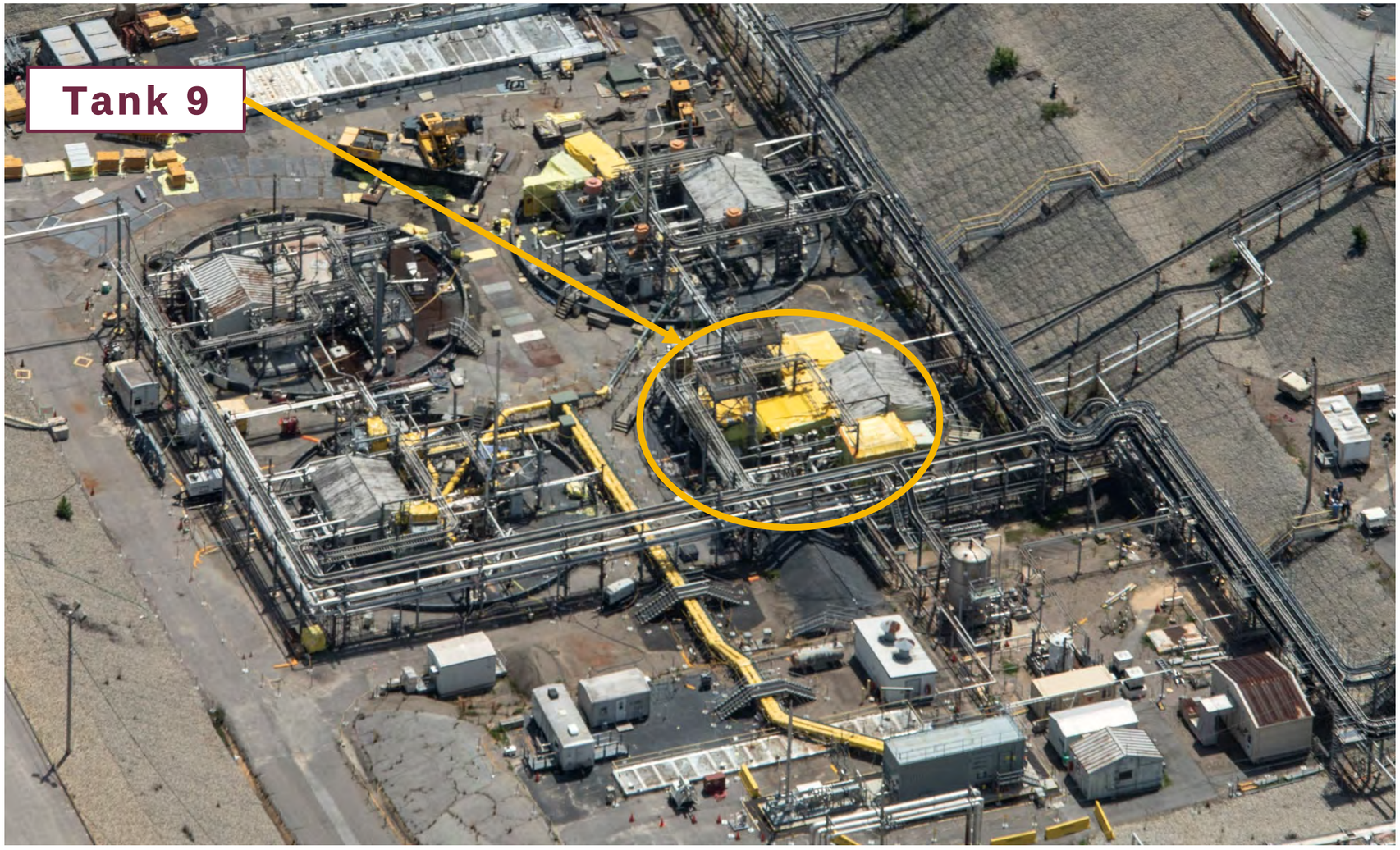
Goals

1. Reduce risk to the environment by removing waste and closing tanks with a goal of completion of the liquid waste program by 2037.
2. Reduce operational and environmental risk by aggressively removing curies from the waste tanks.
3. Reduce operational and environmental risk by optimizing operations to minimize liquid waste program total life cycle.
4. Complete waste removal and subsequent grouting of all waste tanks and ancillary structures with a risk-based priority order: first to tanks in the water table, followed by F Tank Farm tanks, followed by remainder of waste tanks, followed by ancillary structures, recognizing the potential for future emergent conditions or opportunities.

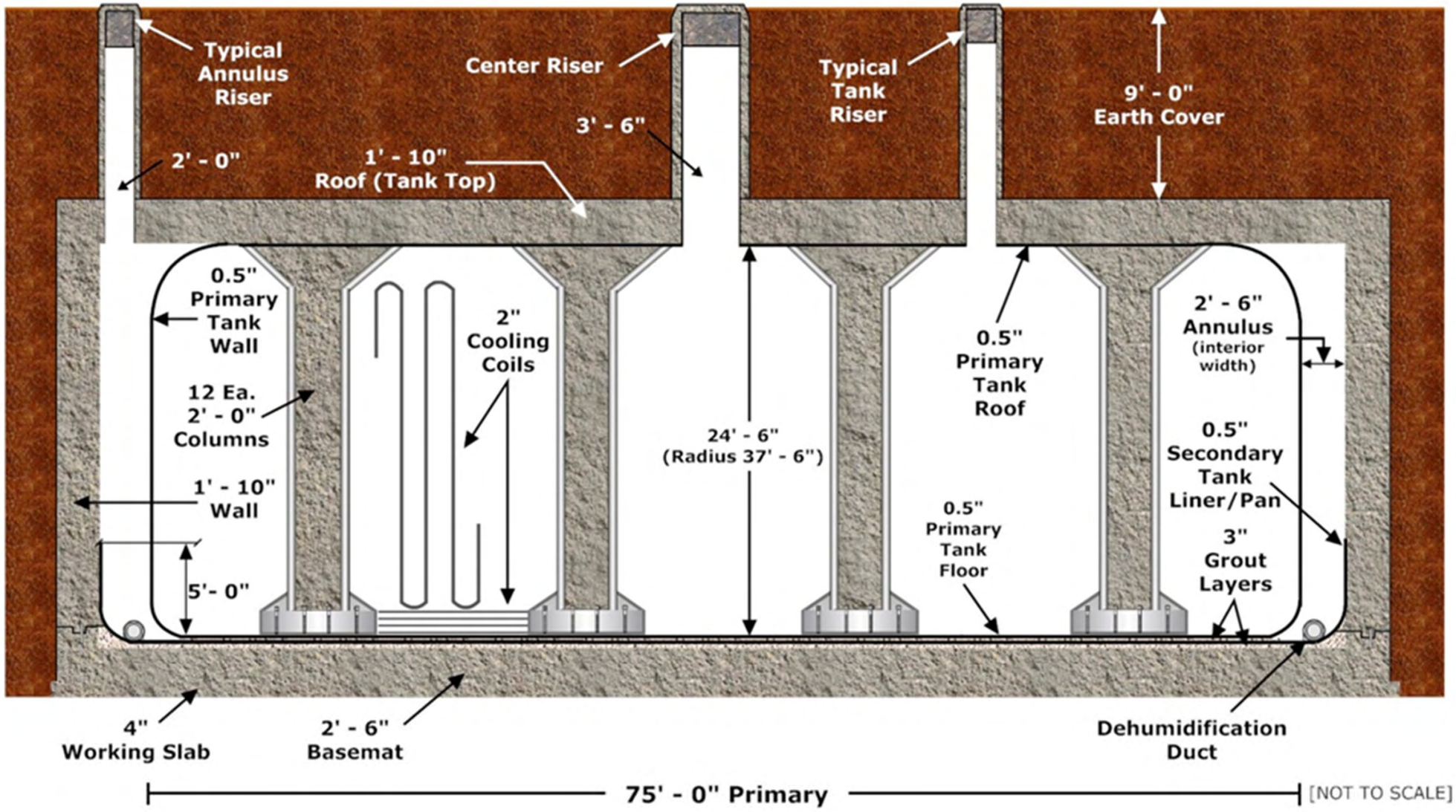
***From Federal Facility Agreement (FFA) 2022 High Level Waste Tank Milestones Agreement* [WSRC-OS-94-42]**

Background Information

Tank 9



Typical Type I Tank



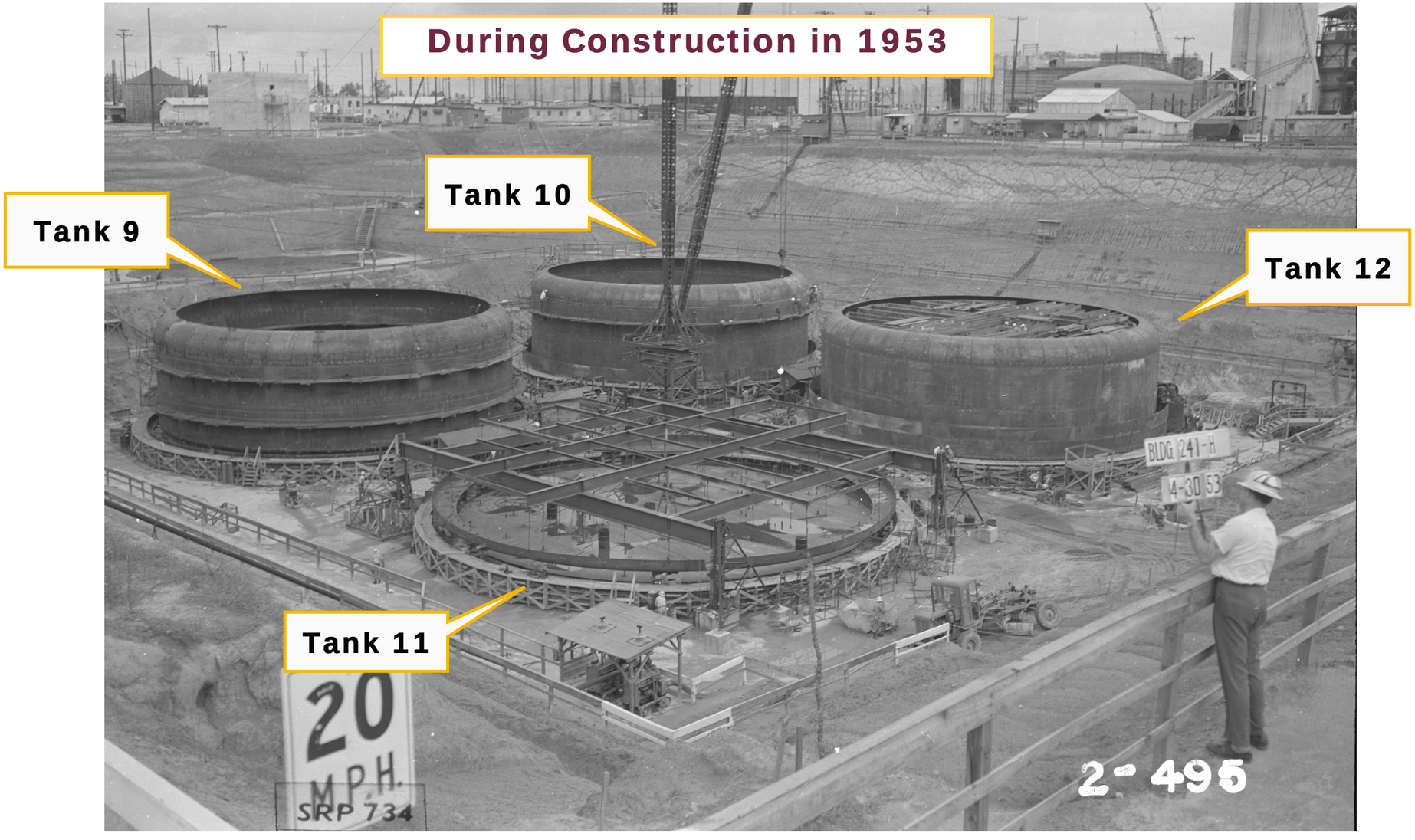
[SRR-CWDA-2017-00015]

Typical Type I Tank

- **Carbon steel primary tank and secondary liner (annular pan) all contained in a concrete vault**
- **Nominal working capacity: 750,000 gallons**
- **For a Type I Tank, 1” of waste equals 2,710 gallons**
- **Primary tank diameter: 75 feet**
- **Primary tank height: 24.5 feet**
- **Annular pan diameter: 80 feet**
  - 2.5-foot annular space surrounding primary
- **Annular pan height: 5 feet**
- **12 interior support columns**
  - 2-foot diameter
- **34 vertical cooling coil runs suspended from the ceiling**
- **2 horizontal cooling coil runs supported above the floor**

[SRR-CWDA-2017-00015]

HTF Type I Tanks

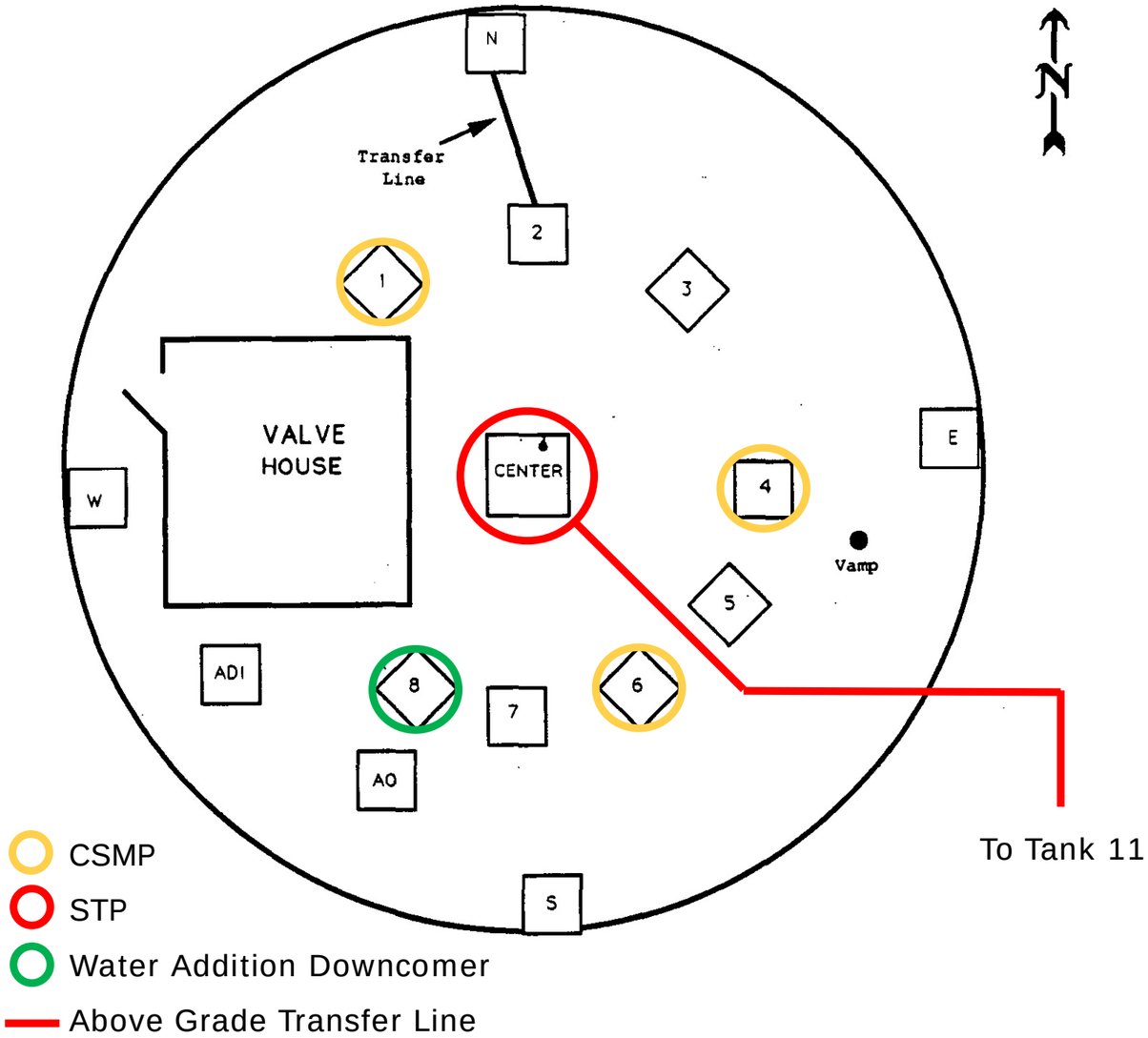


Typical Type I Tank Challenges

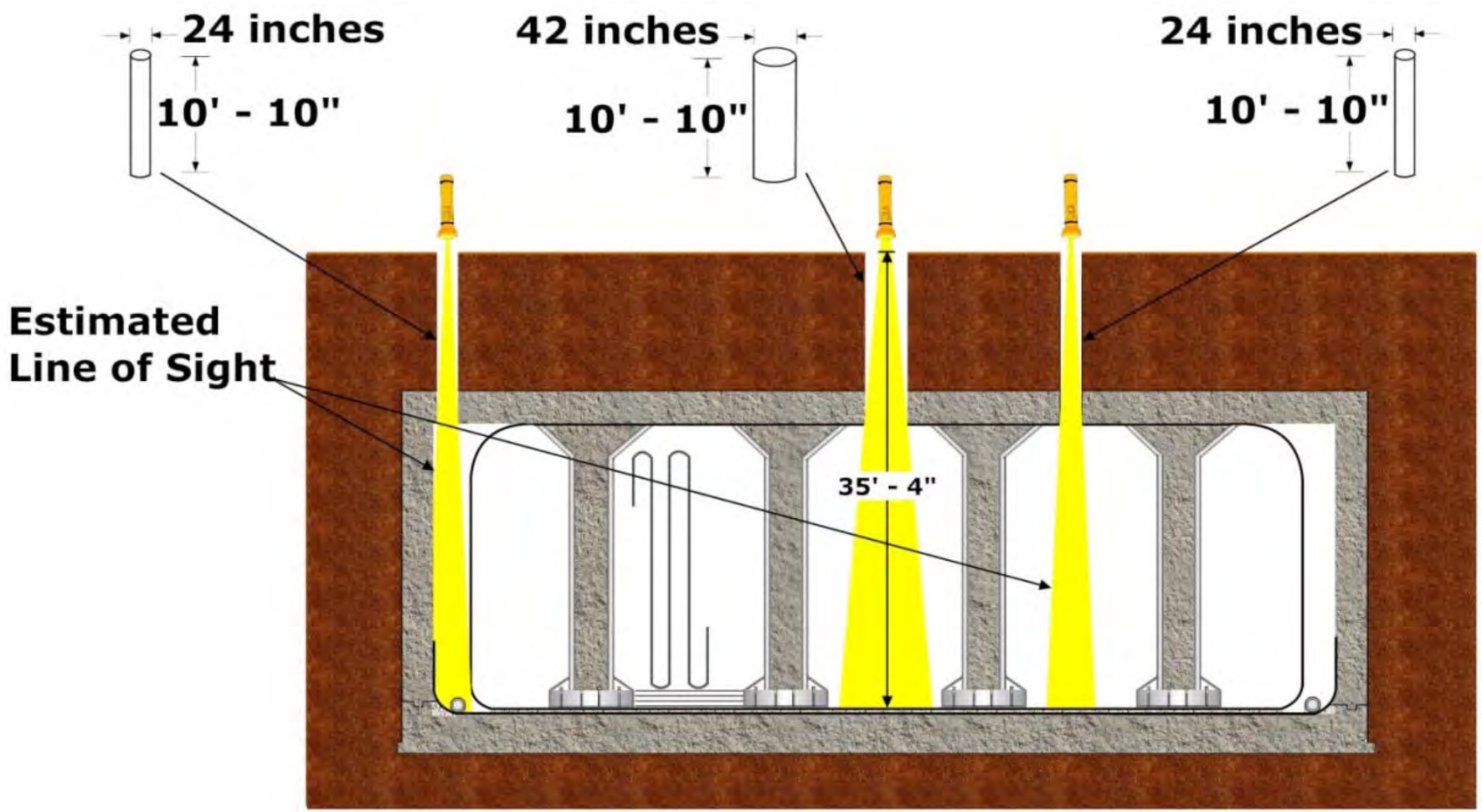
- **Type I tanks some of the most challenging waste tanks in H-Tank Farm (HTF) for removal of solids**
- **Challenges include:**
  - Limited access ports (risers)
  - Presence of roof support columns
  - Approximately 22,800 linear feet (over four miles) of 2-inch inner diameter vertical and horizontal cooling coils
  - “Field-to-fit” horizontal cooling coil “fences”
- **Tanks were not designed with waste removal in mind**

Type I Tank Riser Limitations

- **Primary access**
  - Eight 24-inch risers
  - One 42-inch central riser
- **Annulus access**
  - Four 24-inch risers
- **Limited riser entrances hinder:**
  - Pump placement
  - Cleaning operations
  - Camera viewing
  - Sampling options



Type I Tank Riser Limitations



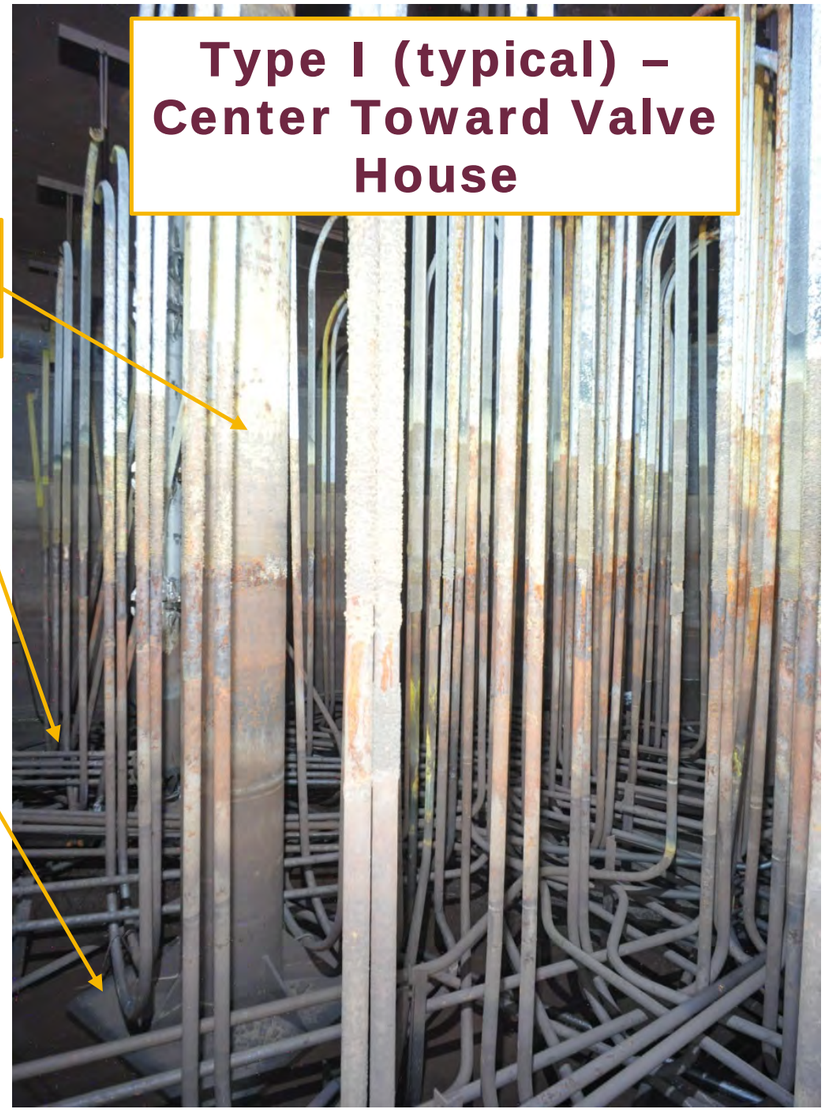
NOTE: Risers may be impeded by installed equipment.

[NOT TO SCALE]

[SRR-CWDA-2017-00015]

Type I Tank Columns and Cooling Coils

- **A total of 12 support columns in each Type I tank**
  - Carbon steel filled with concrete
  - 2-foot diameter
  - 4.5-foot x 4.5-foot x 4.5-inch base plate
- **Type I tanks contain approximately 22,800 linear feet of 2-inch diameter cooling coils**
- **Horizontal coils were installed "field-to-fit"**
- **Columns and cooling coils together impact installation and/or operation of waste removal related equipment**
  - Effective cleaning radius of pumps
  - Full installation of pumps
  - Sampling device deployment



Type I Tank Cooling Coil Valve House

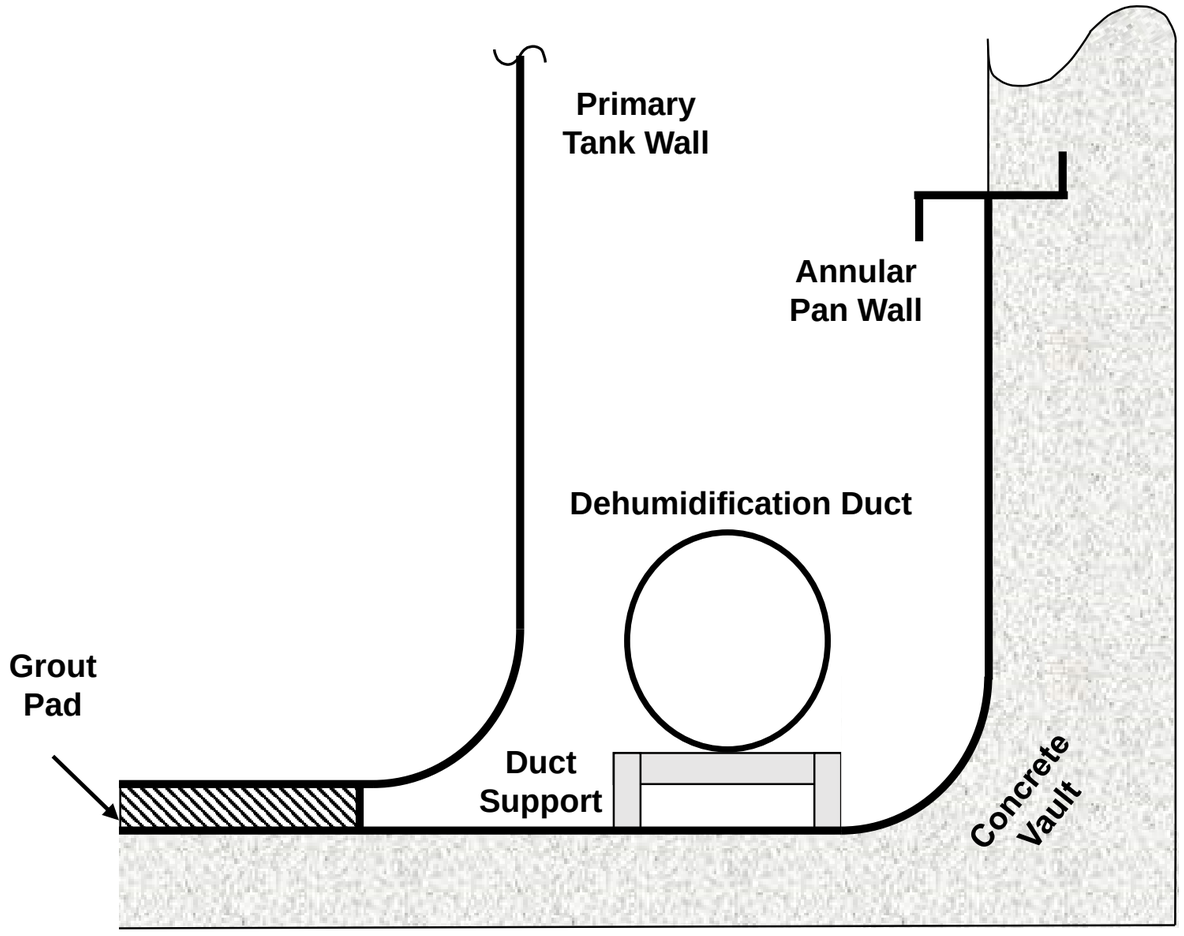
Valve House Interior

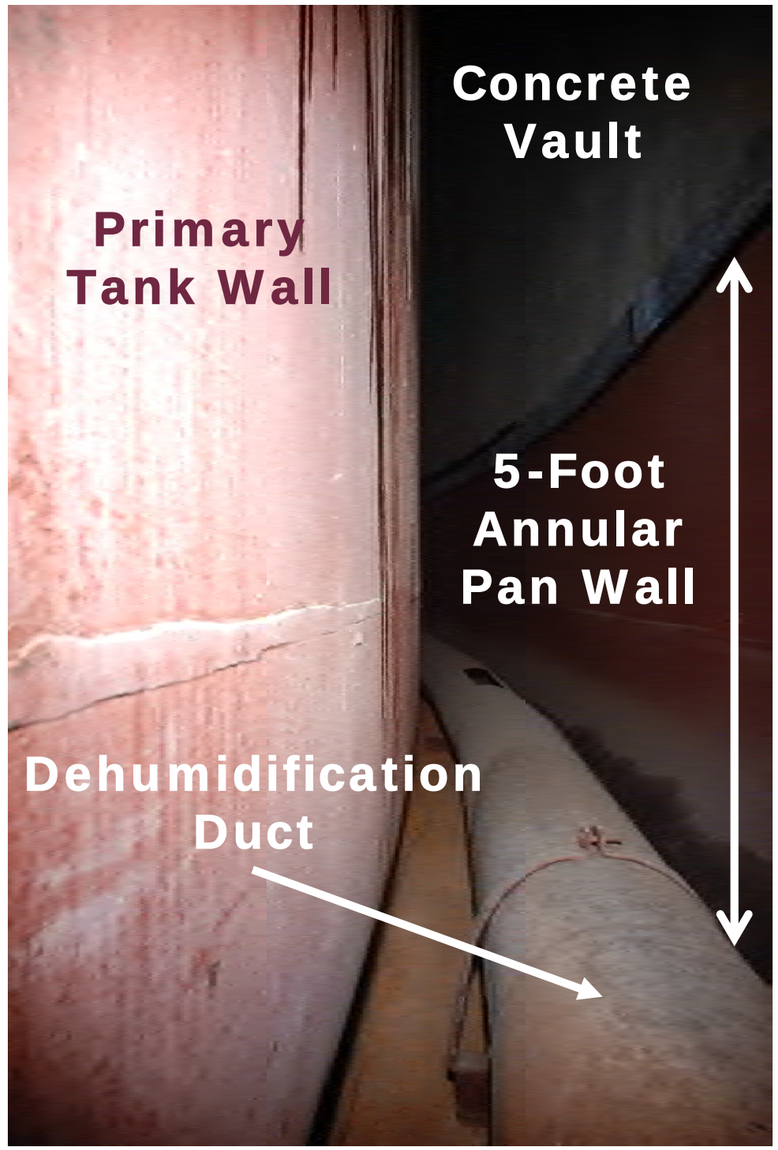
View From Inside Tank (Under the Valve House)

Cooling coil lines entering and exiting waste tank

Type I Tank Annular Region

5-foot high, 80-foot diameter annular pan provides secondary containment





Tank 9 Operational History

- **Constructed between 1951 and 1953**
- **Received High Heat Waste (HHW) from the Plutonium-Uranium Extraction Process (PUREX) from 1955 through 1958**
- **Maximum historical waste level in 1958**
  - 273” or ~740K gallons
- **Waste Removal Phase 1 performed from 1965 through 1966**
  - ~542K gallons of liquid transferred out of Tank 9 to Tank 13, bringing liquid level to 56” (~152K gallons)
  - ~42K gallons of sludge was slurried using high pressure jets and transferred out via submersible mixing pumps (SMPs). The liquid level after this activity was 2.75”
- **Served as a receipt tank for evaporator concentrate from 1967 to 1969**
  - Tank considered full with ~550K gallons of salt and left inactive
- **Waste storage / waste retrieval activities 1969 to present**
  - Waste retrieval resumed in 2019 to support feed for the Tank Closure Cesium Removal (TCCR) Unit
- **First material discovered in annulus pan in 1957 (leak site unknown)**
  - Nine annulus flushes were completed from 1958 to 1959 to return salt to the Tank 9 primary
  - As of 2023, at least four leak sites identified, three of which have known locations
  - There were approximately 8-10” of salt waste in the annulus pan (at ~400 gallons/inch) prior to annulus cleaning activities

[DPSPU-79-11-1, DPSP-69-1-11, SRMC-STI-2024-00076]

Tank 9 Historical Timeline

1955 — Tank 9 Placed into Service as a Receipt Tank for PUREX HHW

1958 — Liquid Level Reaches Historic High of 273”

1965-1966 — Waste Removal Phase 1 – Tank Prepared to be an Evaporator Concentrate Receipt Tank

1967 — Tank 9 Begins Receiving Evaporator Concentrate

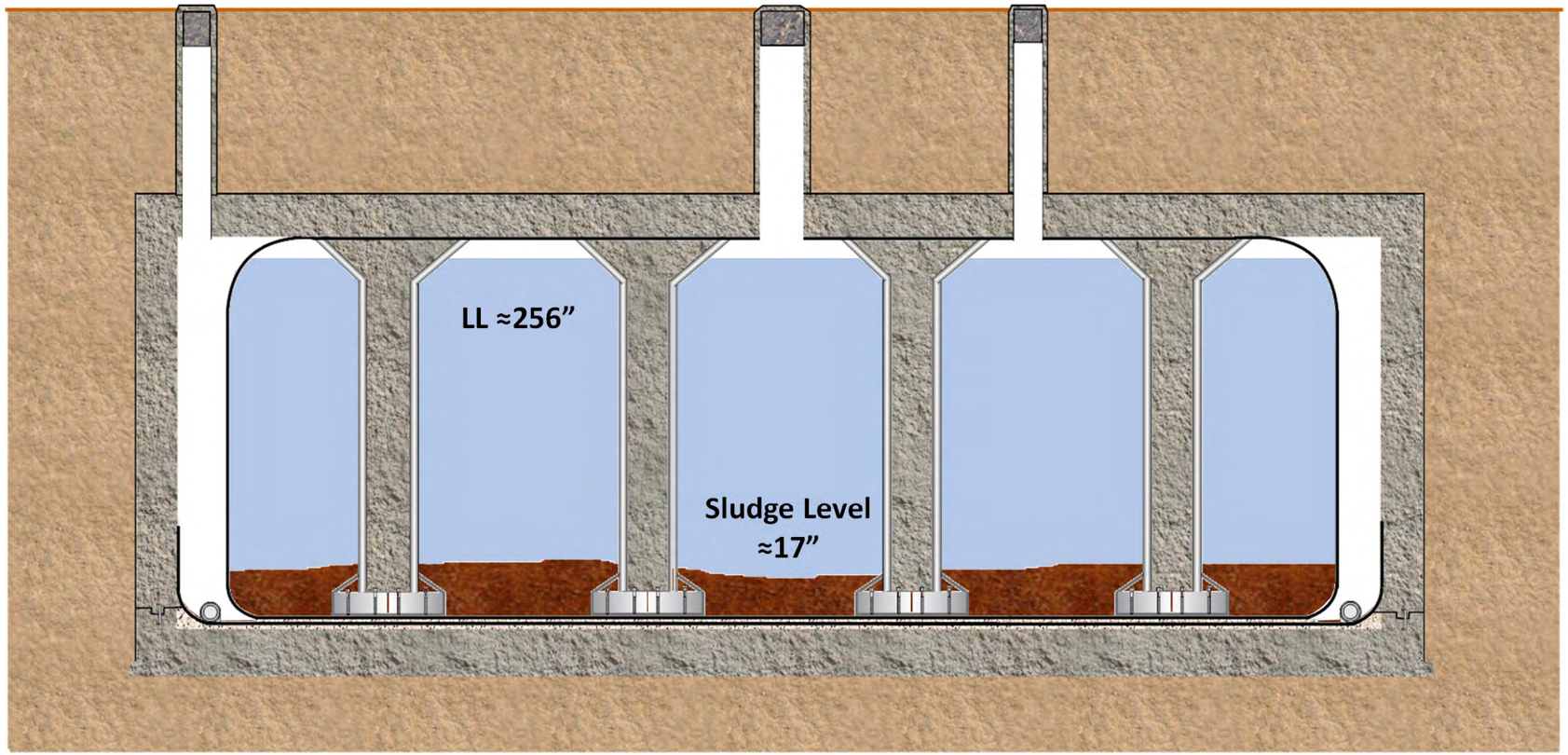
1969 — Tank Filled and Left Inactive

2019-2022 — Waste Removal Phase 2 – Salt Dissolution To Support TCCR Processing

2023-2024 — Waste Removal Phase 3 – Tank Prepared for Closure

Tank 9 Waste Removal Phase 1

Tank 9 Before the Start of Waste Removal Phase 1 (1965)



LL - Liquid Level

[DPSPU-79-11-1]

Tank 9 Waste Removal Phase 1

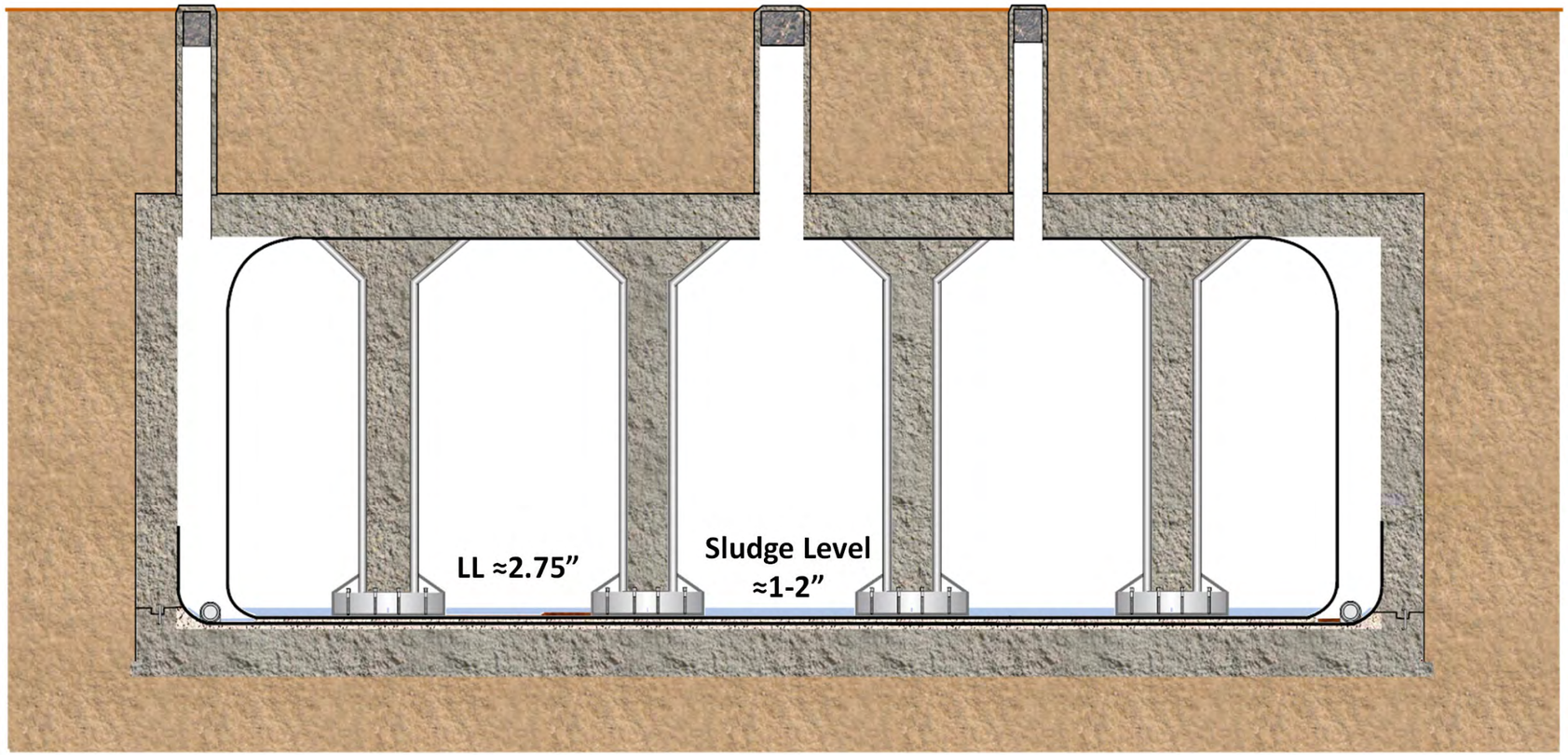
- **Supernate and solids removed to prepare Tank 9 to be a 242-H Evaporator concentrate receipt tank**
  - Removed ~542K gallons of supernate above sludge solids in December of 1965
  - Sludge removal utilized high-pressure sluicers and multiple transfer pumps
  - Removed ~240K gallons of sludge slurry (~42K gallons of sludge)
  - Estimated remaining sludge volume of approximately 2,700 – 5,400 gallons (~1-2”)

High-Pressure Sluicing Device

[DPSPU-79-11-1, DPSP-65-1-12-S, DPSP-66-1-8-S, DPST-70-512]

Tank 9 Waste Removal Phase 1

Tank 9 After Waste Removal Phase 1 (1967)



[DPSPU-79-11-1, DPSP-66-1-8-S, DPST-70-512]

Tank 9 Post Waste Removal Phase 1

- **Tank 9 was used as a receipt tank for 242-H Evaporator concentrate from 1967 to 1969**
- **Tank 9 was deemed full with ~550K gallons in November of 1969**
- **Tank was left inactive until 2019, during which time the liquid level decreased due to cooling and evaporation**
- **As of June 2019, Tank 9 was estimated to contain 203.5” (~551K gallons) of waste**
  - *Historical documentation on sludge level within the tank prior to being used as a concentrate receipt tank from 1967 to 1969 varies, early documentation estimated 1-2”*

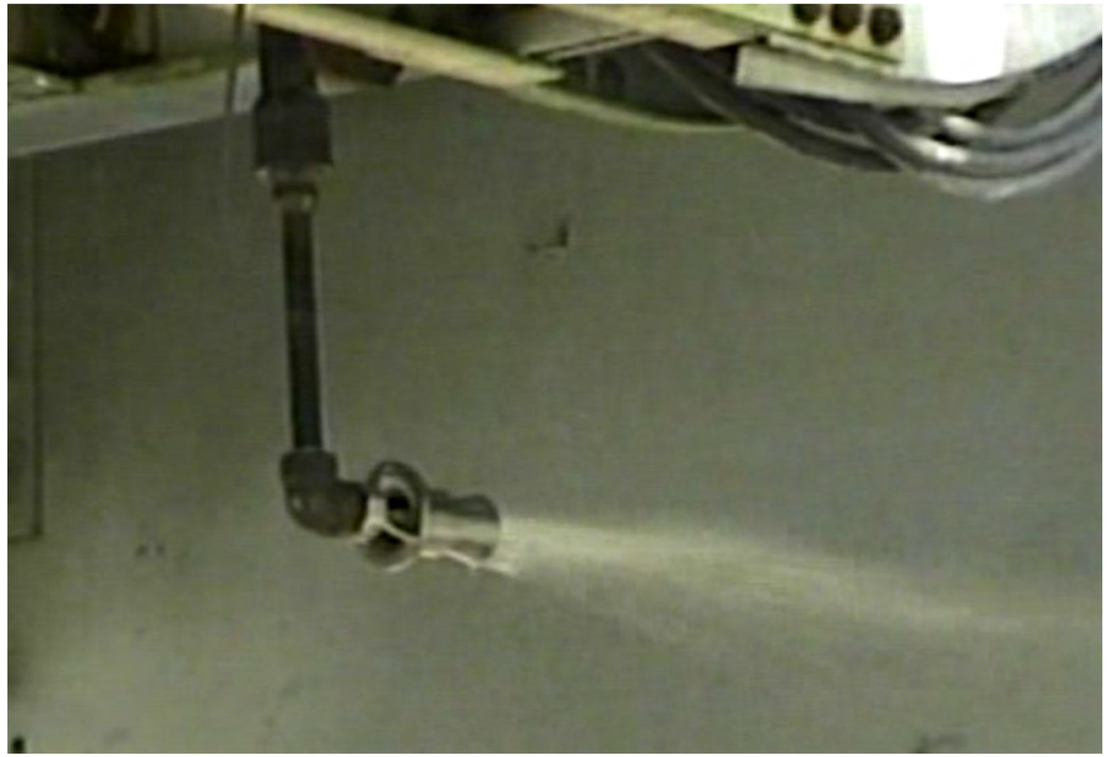
[DPSPU-79-11-1, DPSP-69-1-11, U-ESR-H-00181 Rev. 1]

Tank 9 Prior to Waste Removal Phase 2

Tank 9 Waste Removal Phase 2

- **A Low Volume Mixing Jet (LVMJ) was installed in Riser 4 and two downcomers in Risers 1 and 8 to begin Phase 2**
  - LVMJs are deployed when salt level is too high to install mixing pumps
  - Allowed for distributed water additions, reducing the likelihood of salt peaks forming
- **Hydro-lancing was carried out in both the Center Riser and Riser 7 to support equipment installation**

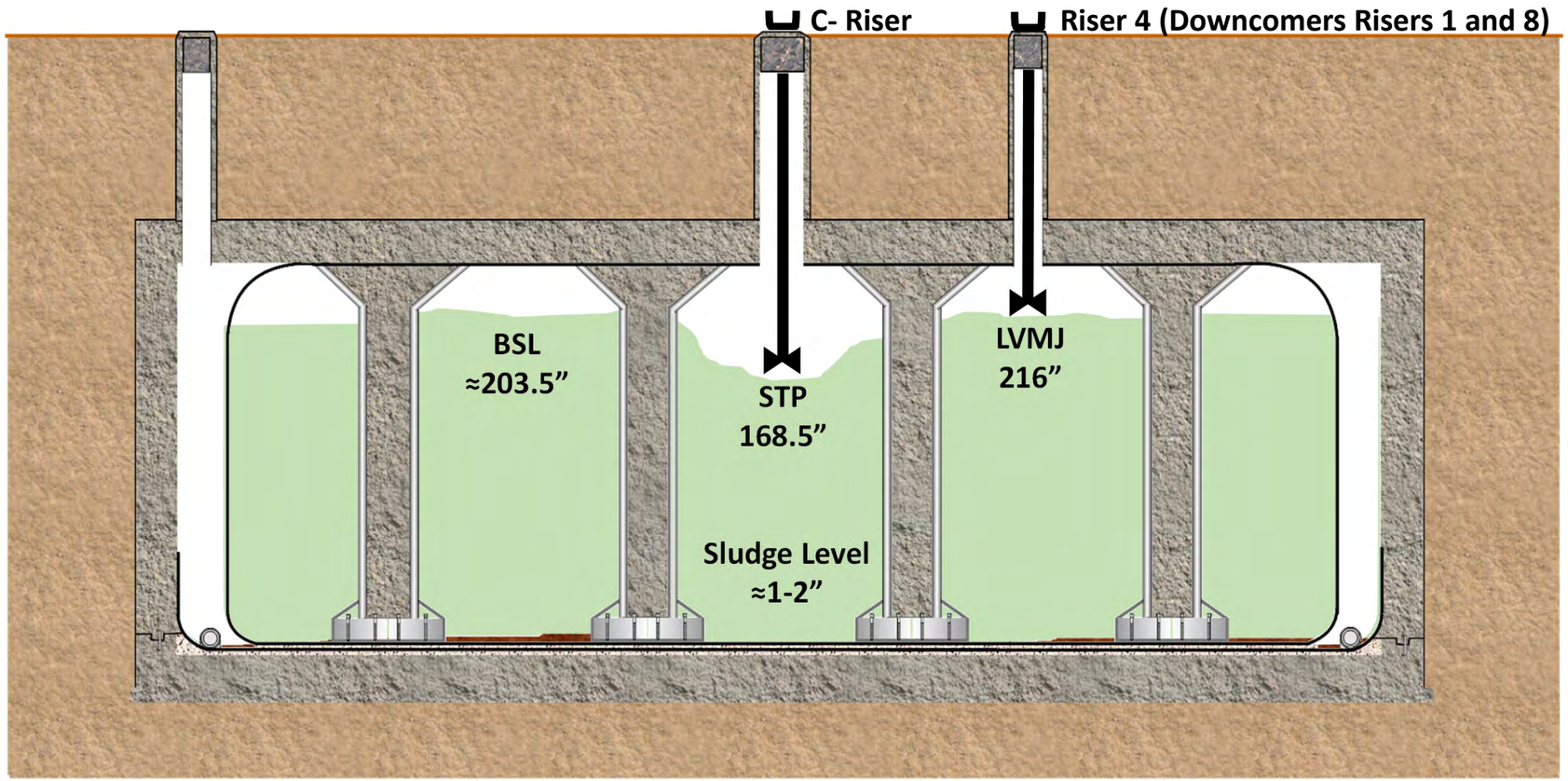
Low Volume Mixing Jet



[U-ESR-H-00181 Rev. 1, U-ESR-H-00182]

Tank 9 Waste Removal Phase 2

Tank 9 Before the Start of Waste Removal Phase 2 (2019)



[DPSPU-79-11-1, DPSP-69-1-11, SW11.1-WTE-7.2 Rev. 130, SW11.1-WTE-7.8 Rev. 23, U-ESR-H-00181 Rev. 1]

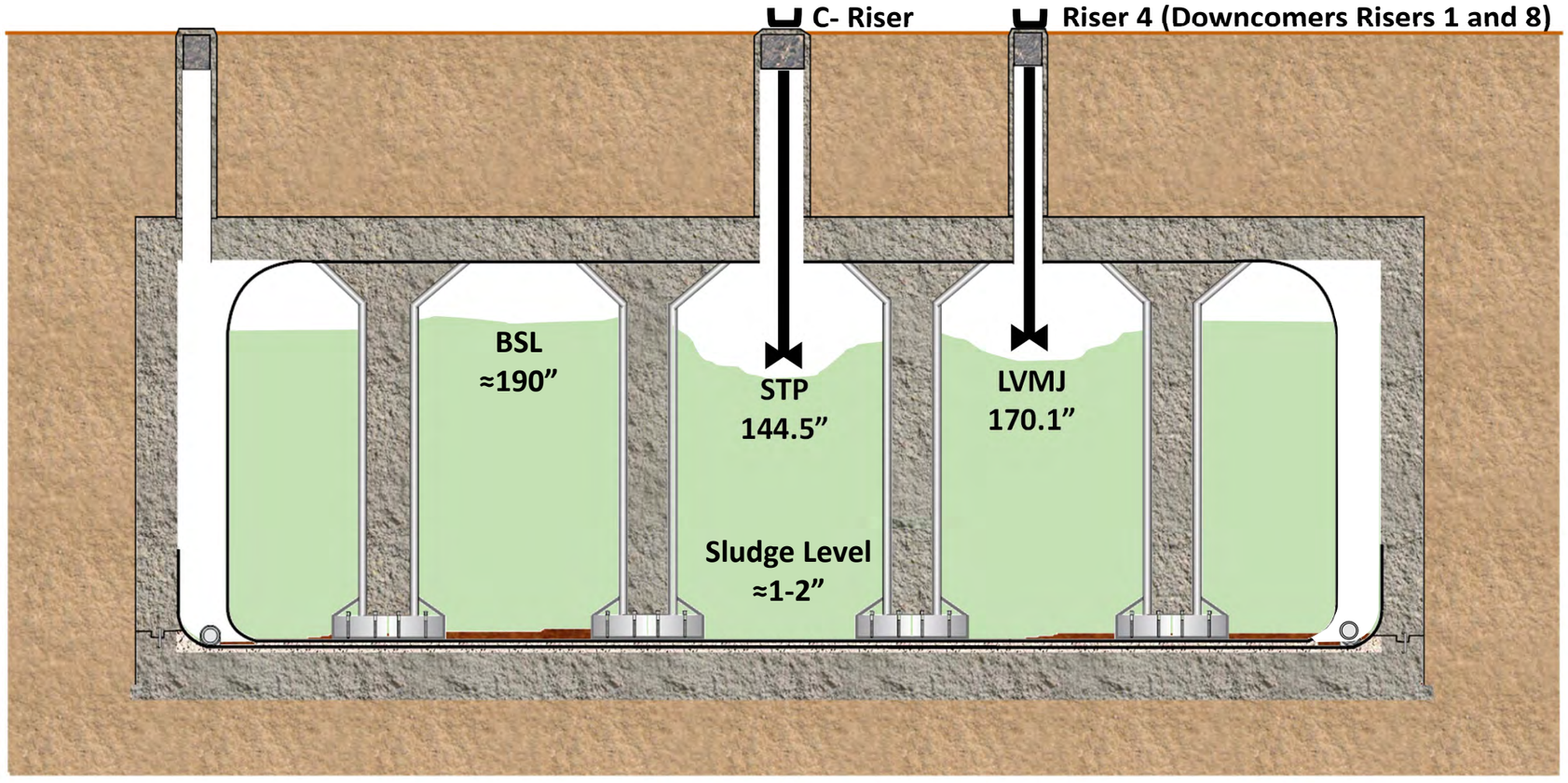
BSL – Bulk Salt Level
LVMJ – Low Volume Mixing Jet
STP – Submersible Transfer Pump

Waste Removal Phase 2 - Salt Dissolution to Support TCCR

- **Waste removal efforts in Tank 9 were undertaken to prepare salt solution for TCCR processing**
- **From June 2019 to March 2020, 30K gallons of water were added to Tank 9 to begin salt dissolution**
- **From May 2021 to June 2022 a total of five cycles of water addition and transfer of Dissolved Salt Solution (DSS) to Tank 10, the TCCR feed tank, took place**
  - LVMJ and STP lowered during dissolution cycles
  - 193K gallons of water were added to Tank 9
  - 237K gallons of DSS were transferred out to Tank 10
  - The Bulk Salt Level (BSL) was reduced from 203.5” to 190”
- **In July of 2022, the decision was made to pause TCCR operations in order to accelerate overall risk reduction (i.e., removal of waste) for Tanks 9, 10 and 11**

[U-ESR-H-00181 Rev. 1, WDPD-20-25, SRR-CWDA-2019-00007 Rev. 28, SRR-CWDA-2019-00007 Rev. 29]

Tank 9 After Waste Removal Phase 2 (July 2022)



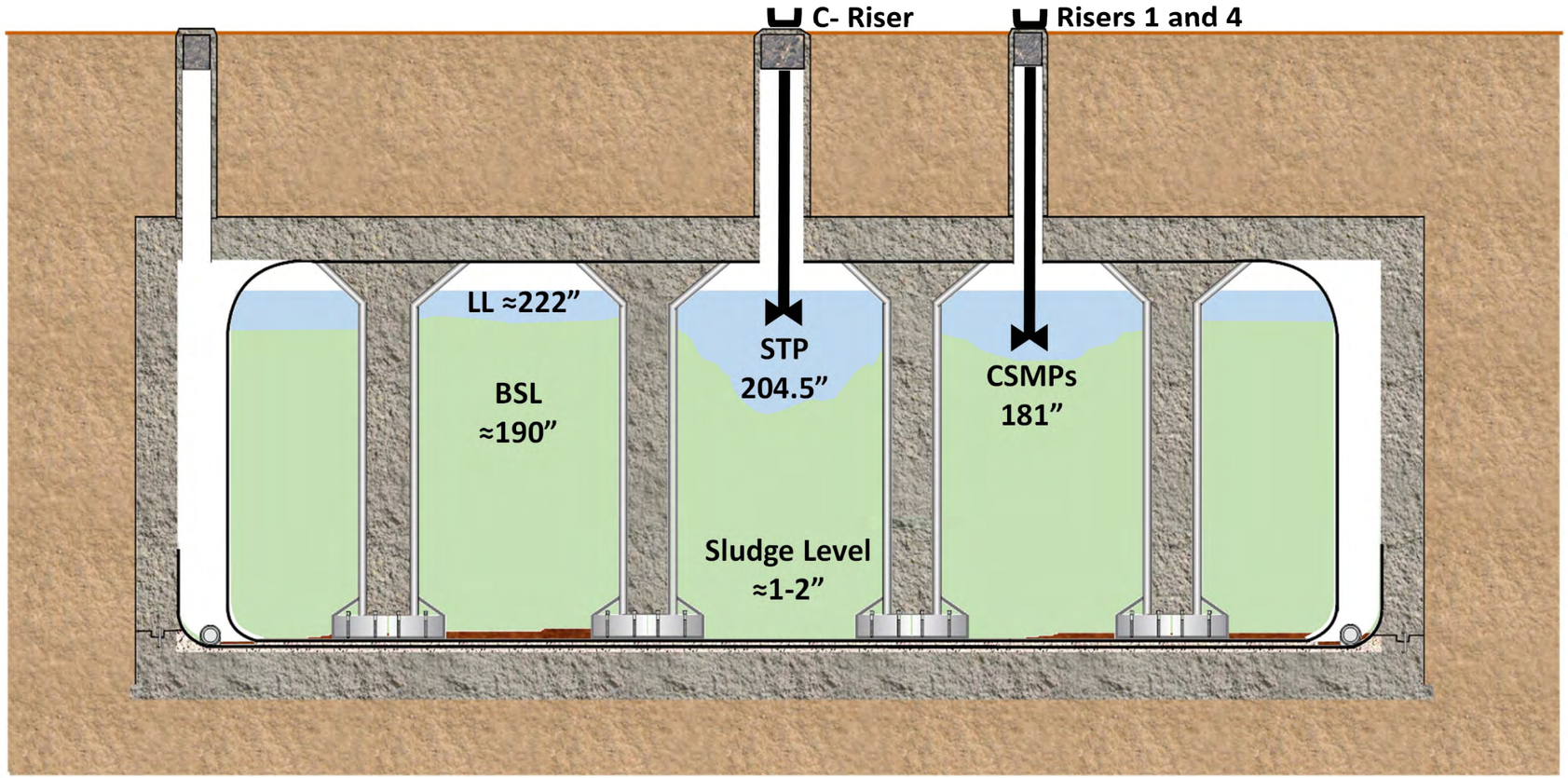
[U-ESR-H-00181 Rev. 2, SRR-CWDA-2019-00007 Rev. 28, SRR-CWDA-2019-00007 Rev. 29, SW11.1-WTE-7.2 Rev. 142, SW11.1-WTE-7.8 Rev. 27]

Bulk Salt Dissolution Preparations

- **Tank 9 equipment was updated and replaced to improve the efficiency of future salt dissolution campaigns for waste removal**
  - LVMJ was removed from Riser 4 and a downcomer was removed from Riser 1
  - Two Commercial Submersible Mixing Pumps (CSMPs) were installed in Risers 1 and 4 at 181”
  - The STP in the Center Riser was replaced
  - A new Hose-in-Hose Transfer Line (HIHTL) was established to allow transfers directly from Tank 9 to Tank 11

Waste Removal Phase 3-Campaign 1

Tank 9 At Start of Waste Removal Phase 3-Campaign 1 (November 2023)

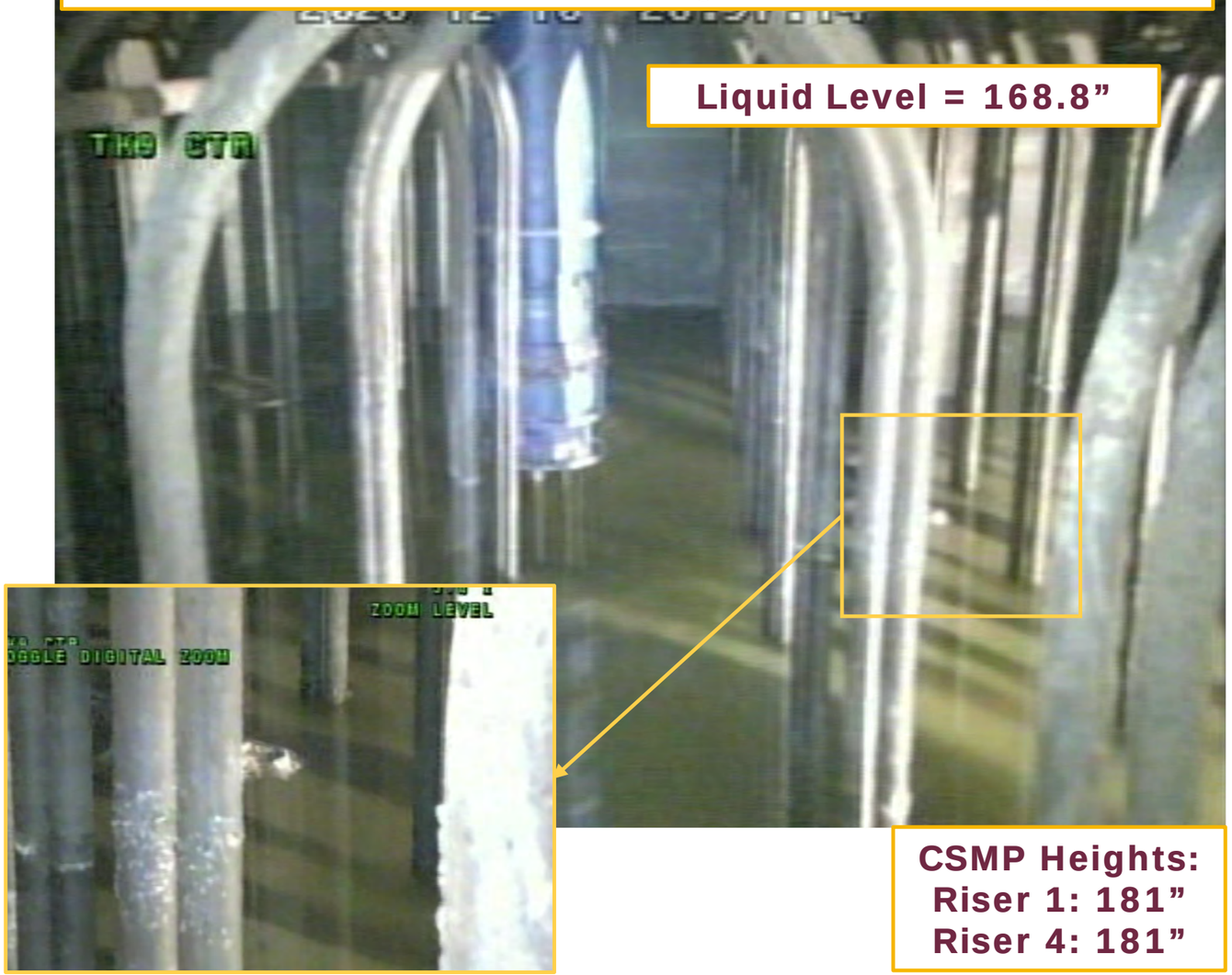


[SW11.1-WTE—7.2 Rev. 157, SW11.1-WTE-7.8 Rev. 34, U-ESR-H-00181 Rev. 2, U-ESR-H-00181 Rev. 2 Add. 1]

Waste Removal Phase 3-Campaign 1

- ~59K gallons of well water added
- Two CSMPs in Risers 1 and 4 operated in oscillation mode at half speed (900 RPM) for ~3.5 days
- Transfer of ~ 136K gallons DSS from Tank 9 to Tank 11 completed on December 11, 2023
- DSS transferred had a density of 1.367 g/mL indicating very good salt dissolution
- BSL estimated to be reduced from 190” to 169”

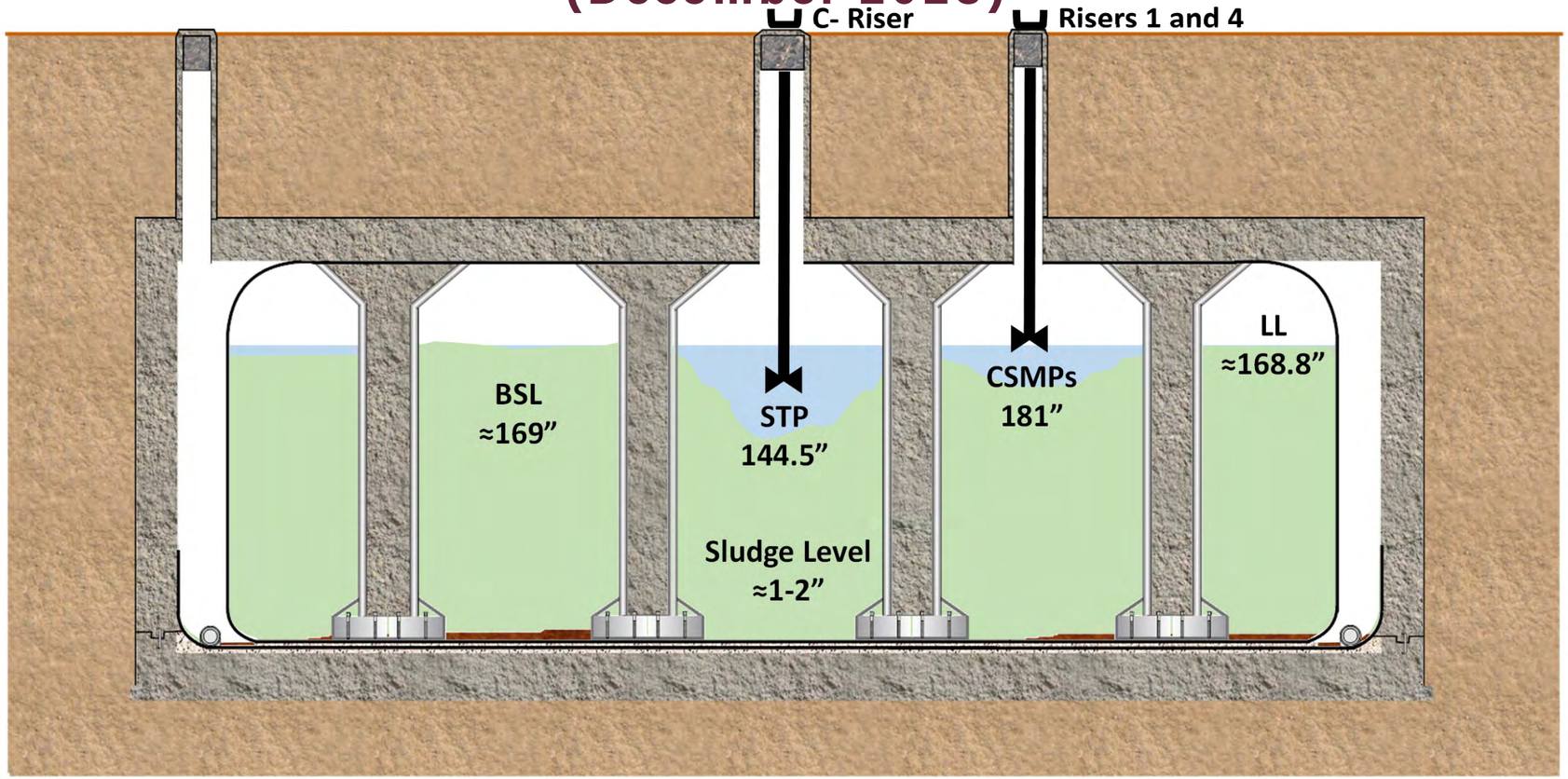
Camera Inspection Following Phase 3-Campaign 1



[U-ESR-H-00181 Rev. 2, U-ESR-H-00181 Rev. 2 Add. 1, G-TRT-H-00465, G-TRT-H-00476, G-TRT-H-00478]

Waste Removal Phase 3-Campaign 1

Tank 9 At Conclusion of Waste Removal Phase 3-Campaign 1 (December 2023)



[G-TRT-H-00476]

Waste Removal Phase 3-Campaign 2

- ~135K gallons of well water added
- Risers 1 and 4 CSMPs lowered to 161”
- CSMPs in Risers 1 and 4 operated at half speed (900 RPM) for ~4 days
- STP lowered to 108.5”
- Transfer of 163K gallons DSS from Tank 9 to Tank 11 completed on January 1, 2024
- DSS transferred had a density of 1.369 g/mL indicating very good salt dissolution
- BSL estimated to be reduced from 169” to 155”

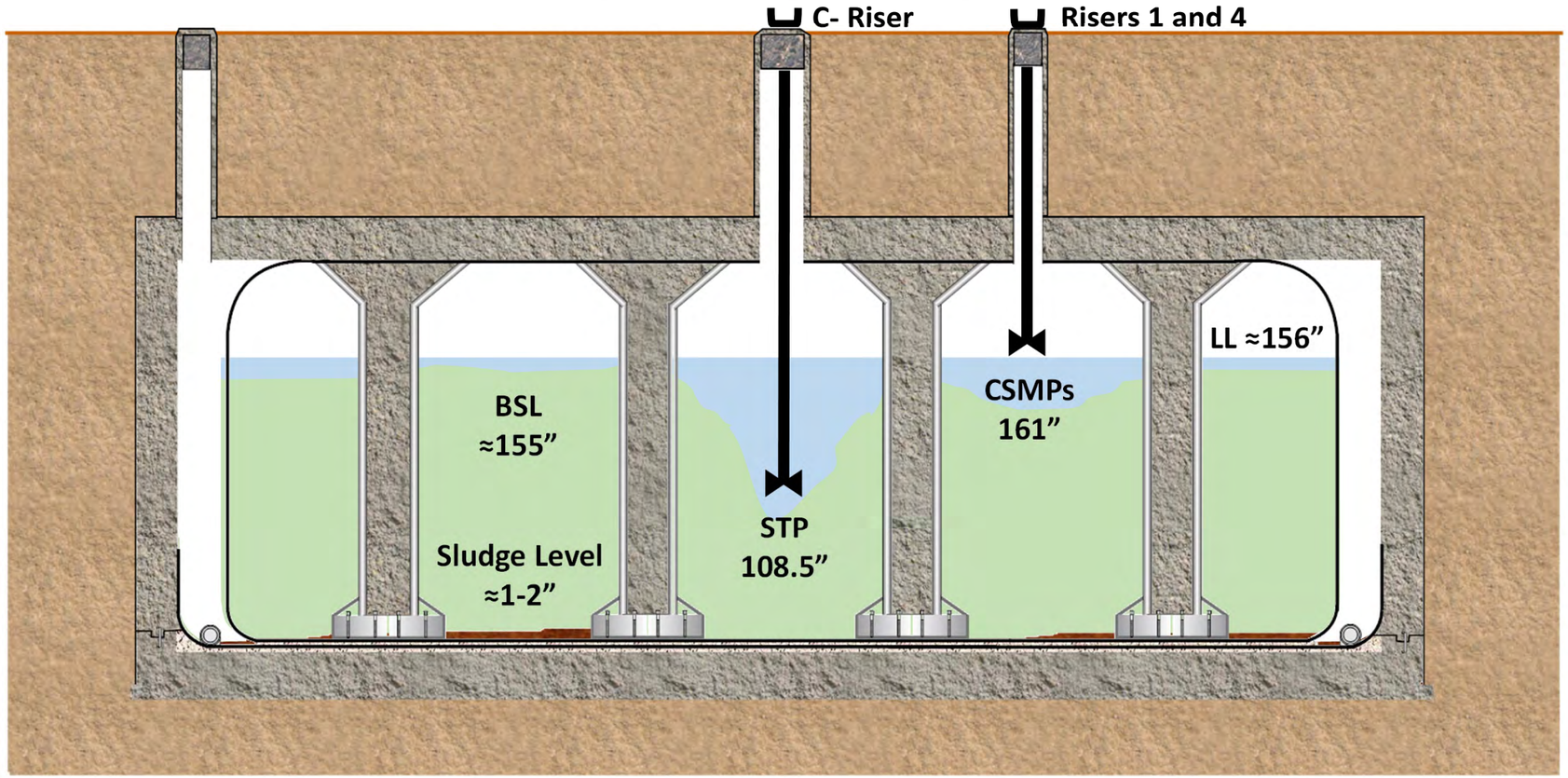
Camera Inspection Following Phase 3-Campaign 2

CSMP Heights:
Riser 1: 161”
Riser 4: 161”

[G-TRT-H-00480]

Waste Removal Phase 3-Campaign 2

Tank 9 At Conclusion of Waste Removal Phase 3-Campaign 2 (January 2024)

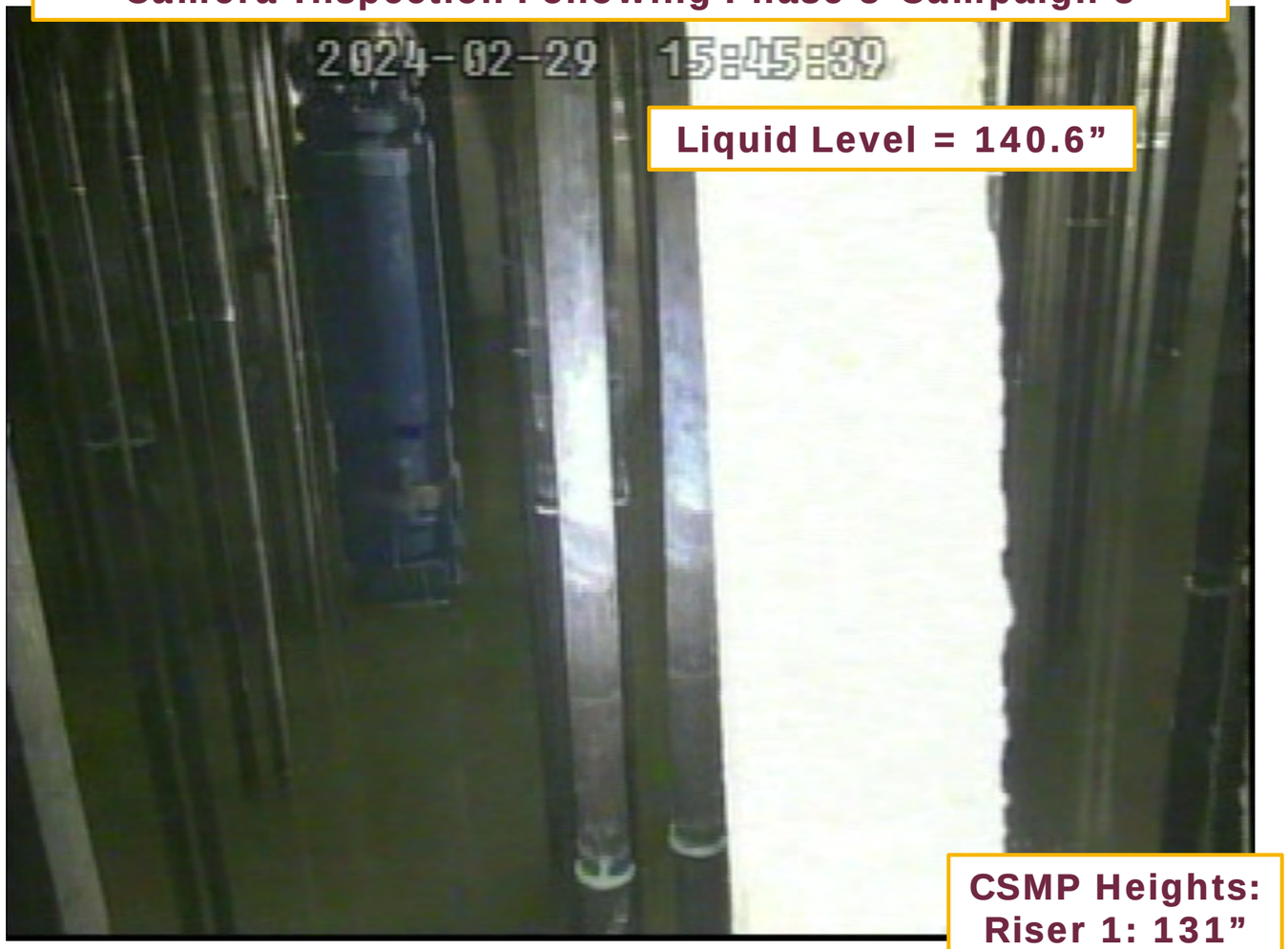


[G-TRT-H-00480, G-TRT-H-00482, SW11.1-WTE-7.2 Rev. 157 IPC-4, SW11.1-WTE-7.8 Rev. 35 IPC 1]

Waste Removal Phase 3-Campaign 3

- Risers 1 and 4 CSMPs lowered to 131”
- STP lowered to 84”
- 153K gallons of well water added
- Two CSMPs in Risers 1 and 4 operated at full speed (~1700 RPM) for ~5 days
- Transfer of 171K gallons DSS from Tank 9 to Tank 11 completed on February 29, 2024
- DSS transferred had a density of 1.374 g/mL indicating very good salt dissolution
- BSL estimated to be reduced from 155” to 143”

Camera Inspection Following Phase 3-Campaign 3

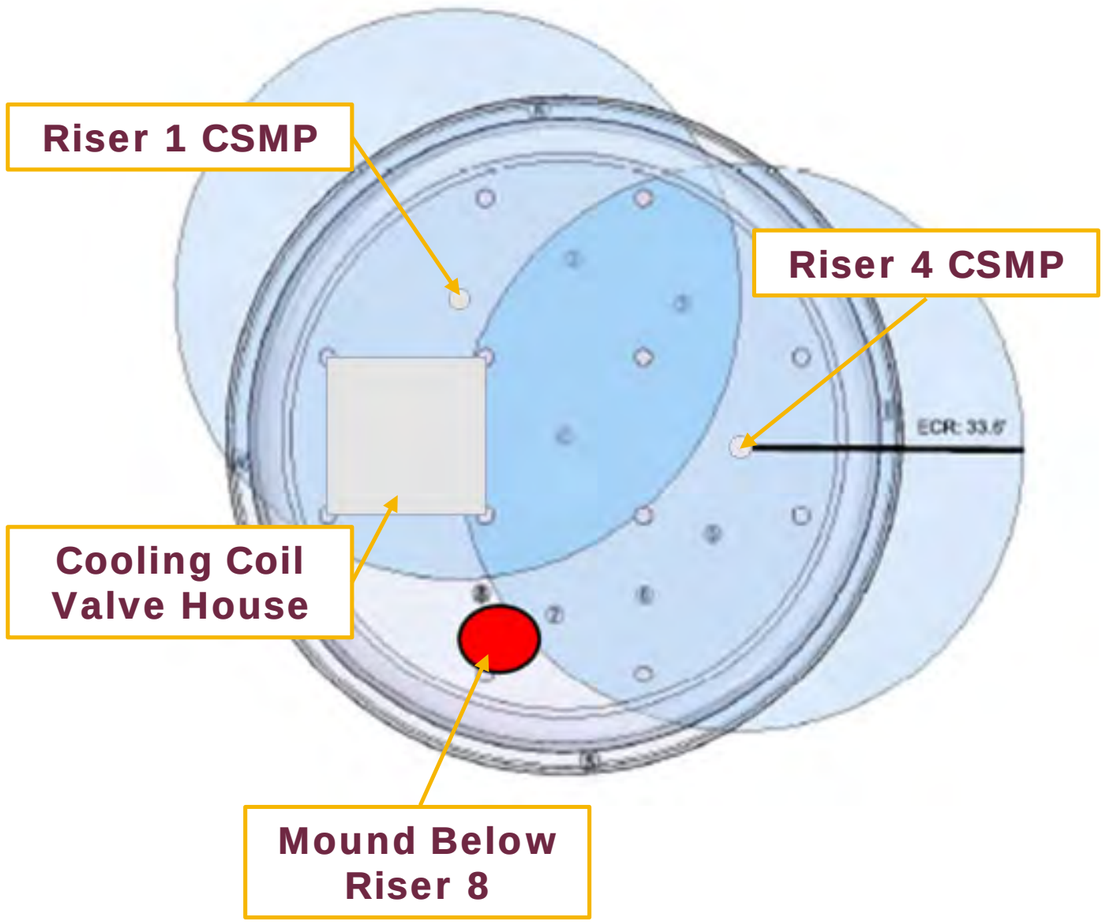


CSMP Heights:
Riser 1: 131”
Riser 4: 131”

[G-TRT-H-00489, G-TRT-H-00490. G-TRT-H-00491]

Waste Removal Phase 3-Campaign 3

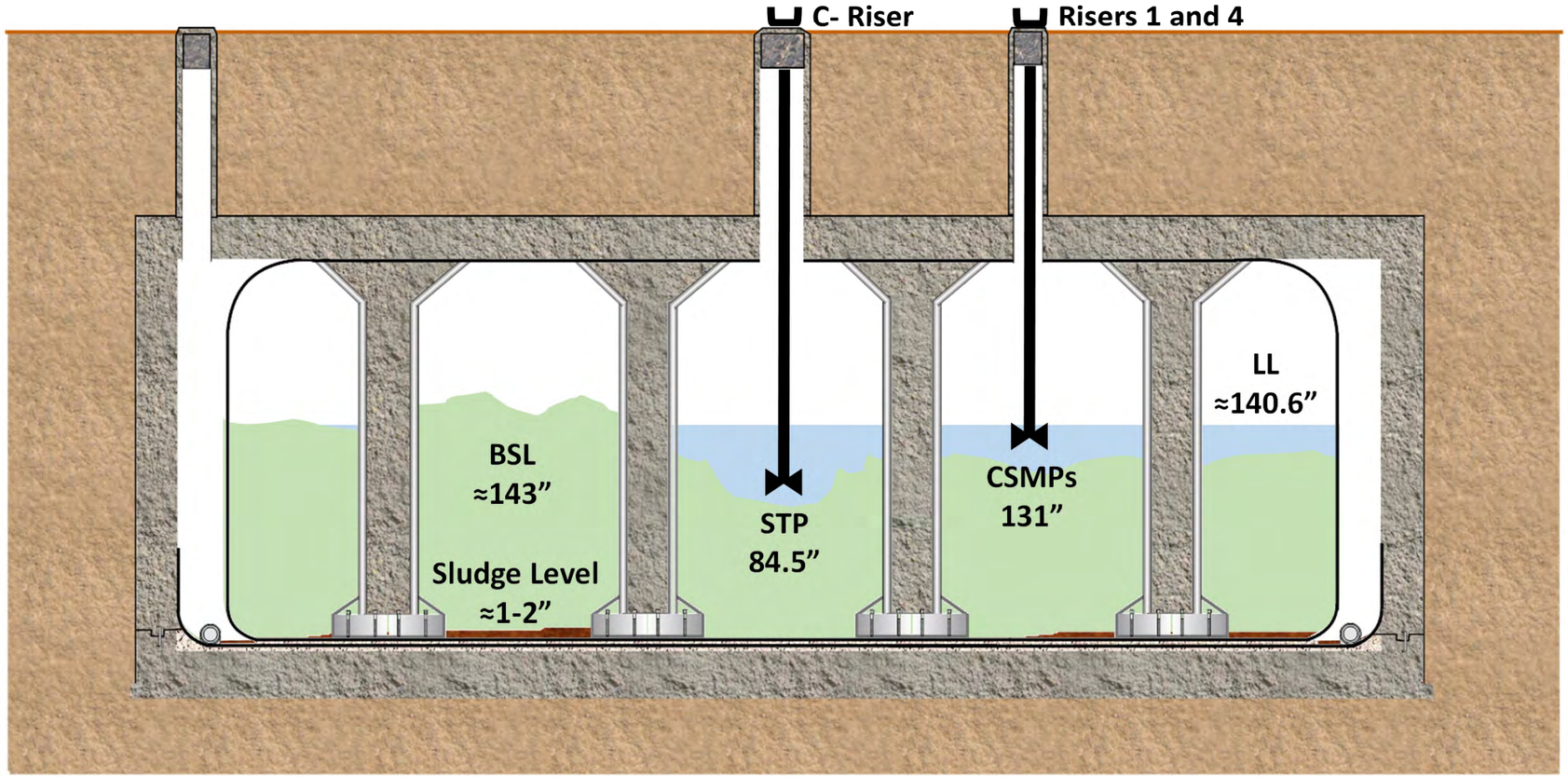
Mound noted beneath Riser 8, outside of the effective cleaning radius (ECR) of the two operational CSMPs



Camera Inspection Following Phase 3-Campaign 3

[G-TRT-H-00491]

Tank 9 At Conclusion of Waste Removal Phase 3-Campaign 3 (February 2024)



[G-TRT-H-00489, G-TRT-H-00490, G-TRT-H-00491, SW11.1-WTE-7.2 Rev. 158 IPC-3, SW11.1-WTE-7.8 Rev. 36]

Waste Removal Phase 3-Campaign 4

- **Risers 1 and 4 CSMPs lowered to 121”**
- **105K gallons of well water and 65K gallons domestic water added**
- **Two CSMPs in Risers 1 and 4 operated at full speed (~1700 RPM) for ~5 days**
  - CSMPs indexed toward Riser 8 for first 72 hours
  - CSMPs set to oscillate for the remaining 48 hours
- **Transfer of 163K gallons DSS from Tank 9 to Tank 11 completed on April 1, 2024**
- **DSS transferred had a density of 1.391 g/mL indicating very good salt dissolution**
- **BSL estimated to be 150”**
  - Salt seen on tank wall

Camera Inspection Following Phase 3-Campaign 4

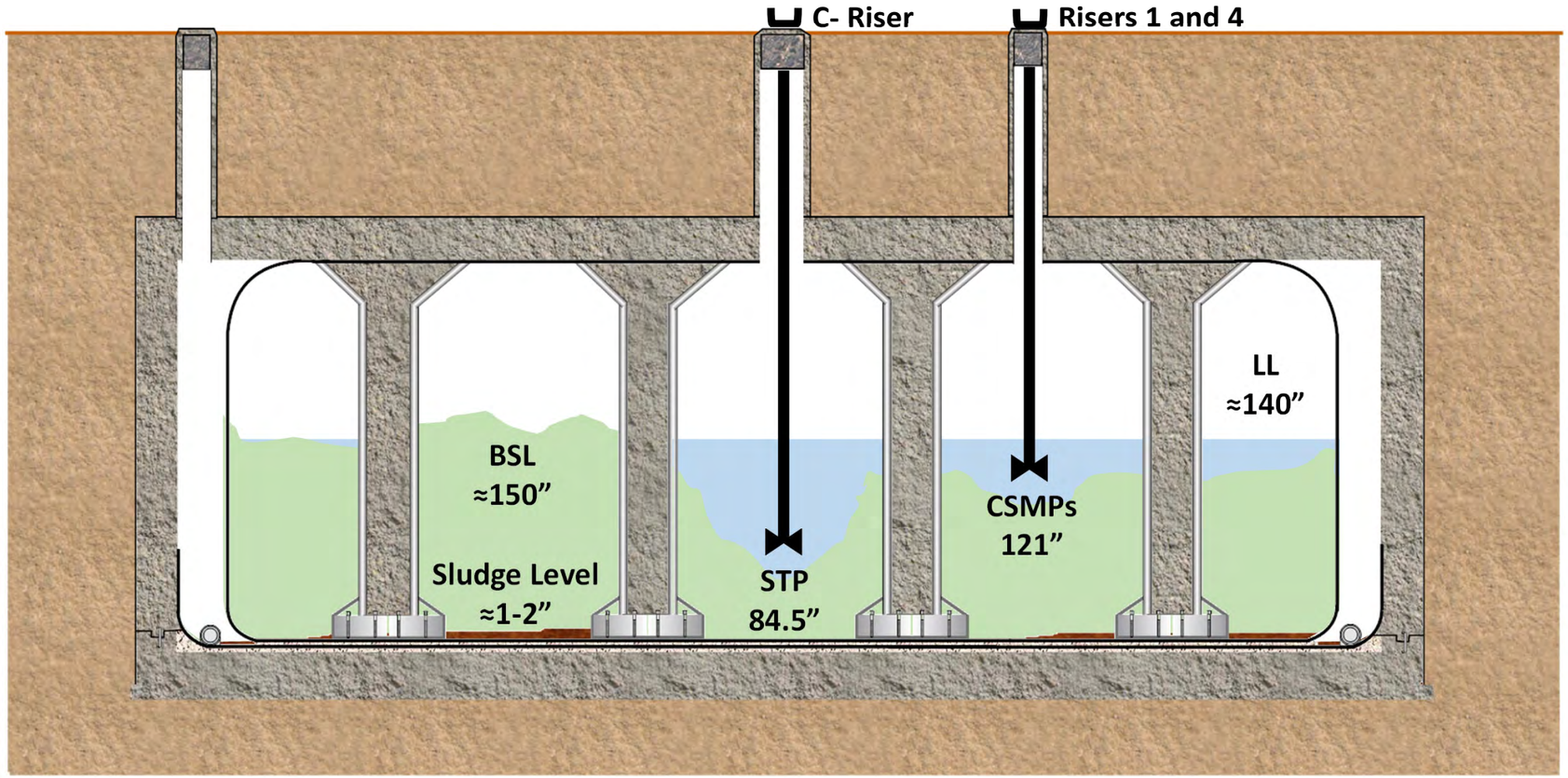
Liquid Level = 140”

CSMP Heights:
Riser 1: 121”
Riser 4: 121”

[U-ESR-H-00181 Rev. 2 Add. 4, G-TRT-H-00496, G-TRT-H-00499, G-TRT-H-00503]

Waste Removal Phase 3-Campaign 4

Tank 9 At Conclusion of Waste Removal Phase 3-Campaign 4 (April 2024)



[G-TRT-H-00499, SW11.1-WTE-7.2 Rev. 159 IPC-3, SW11.1-WTE-7.8 Rev. 37]

Waste Removal Phase 3-Campaign 5

- A new CSMP was installed in Riser 6 at 141”
- ~153K gallons of domestic water added
- Riser 6 CSMP indexed towards the previously seen mound for ~2 days, oscillated for ~2 days
- All three CSMPs in Risers 1, 4 and 6 were then operated for ~4 days
- STP lowered to 48.5”
- Transfer of ~348K gallons DSS from Tank 9 to Tank 11 completed on May 21, 2024
- DSS transferred had a density of 1.372 g/mL indicating very good salt dissolution
- BSL estimated to be reduced from 150” to 60”
  - No significant mounds
  - Salt on tank wall not visible
  - BSL set to liquid level

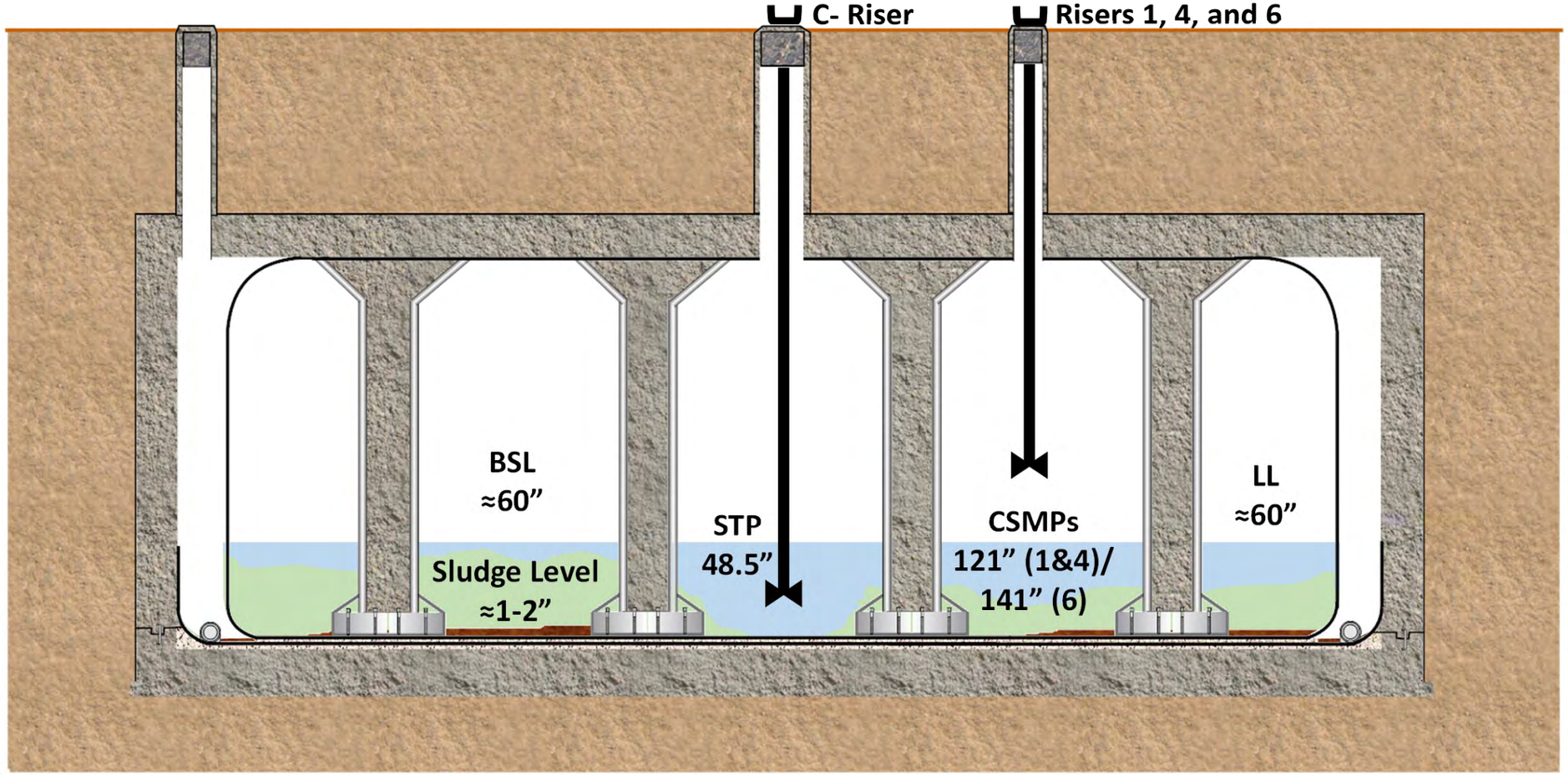
Camera Inspection Following Phase 3-Campaign 5

Liquid Level = 60”

CSMP Heights:
Riser 1: 121”
Riser 4: 121”
Riser 6: 141”

[G-TRT-H-00507, G-TRT-H-00510, G-TRT-H-00511]

Tank 9 At Conclusion of Waste Removal Phase 3-Campaign 5 (May 2024)



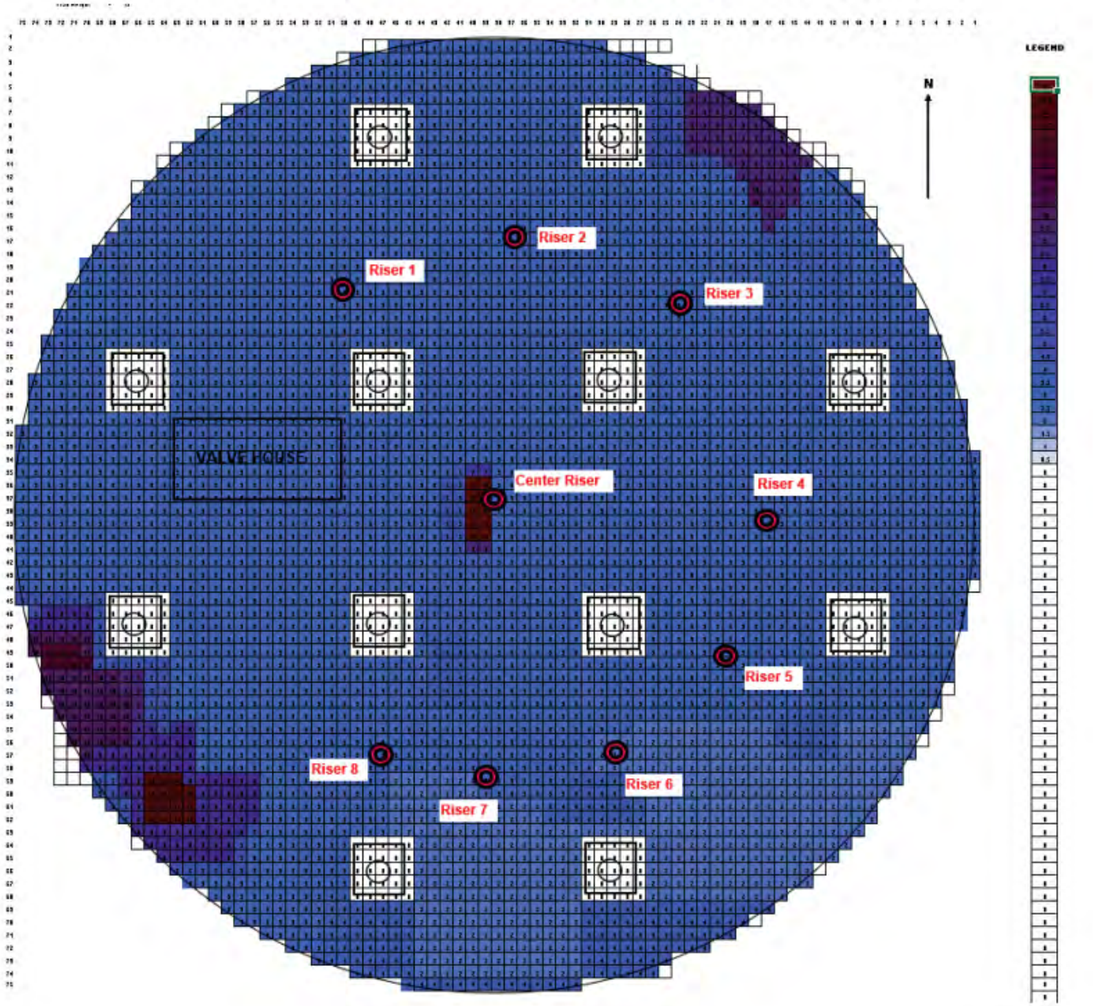
[G-TRT-H-00510, SW11.1-WTE-7.2 Rev. 161, SW11.1-WTE-7.8 Rev. 38]

Waste Removal Phase 3-Campaign 6

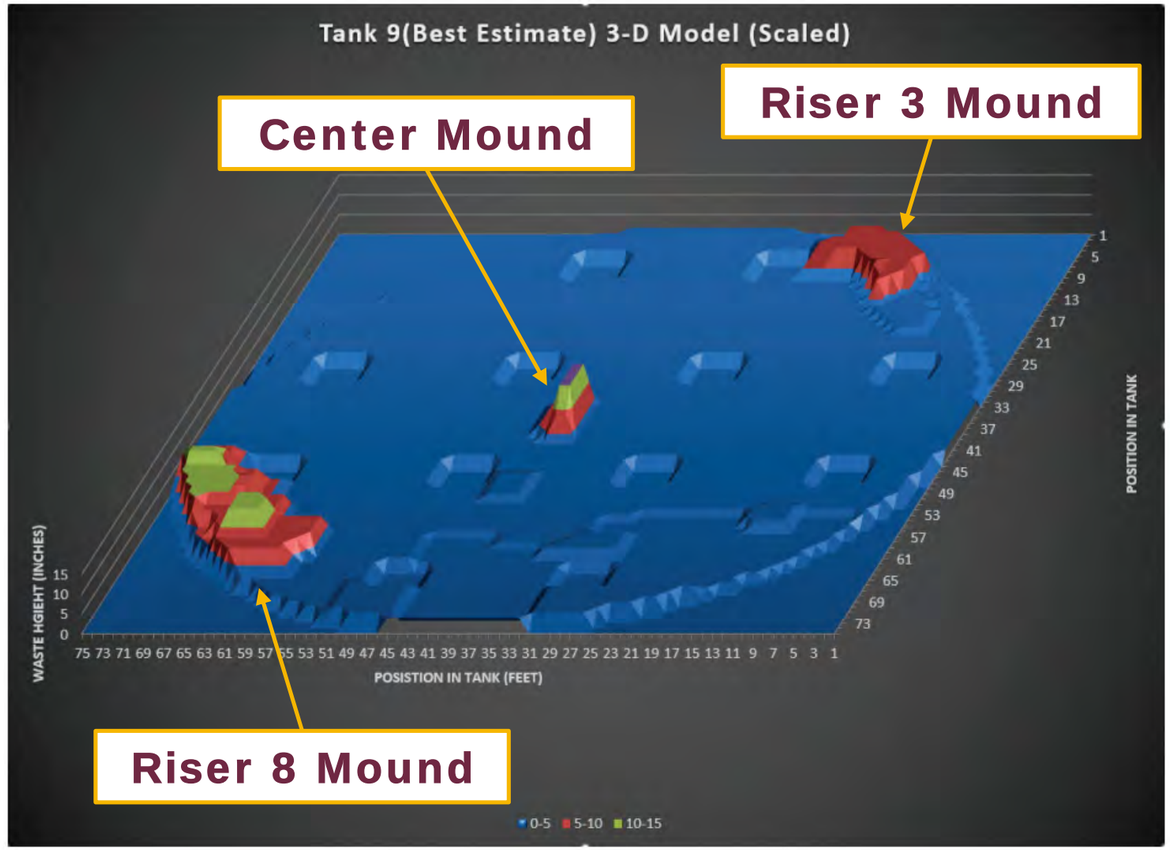
- **~277K gallons of domestic water added**
- **An intermediate mixing campaign (6a) was carried out with all three CSMPs in Risers 1, 4 and 6 operating for ~3 days**
  - No DSS transferred out following initial pump run
- **All three CSMPs were then lowered to 11 inches from the bottom of the tank**
- **A full mixing campaign was then run with CSMPs in risers 1, 4 and 6 in oscillation mode for ~7 days (6b)**
- **The CSMPs were restarted in preparation for a transfer out, however the STP failed and the CSMPs were again shutdown after running in oscillation mode for ~5 days**
- **The failed STP was replaced and the CSMPs restarted to run through the transfer of ~417K gallons of DSS to Tank 11, concluding on July 15, 2024**
  - Final liquid level ~ 7”
- **At the conclusion of the DSS transfer a map of the estimated remaining solids was created**
  - Estimated ~8,500 gallons of solids
  - Mounds were noted along the wall behind Riser 3 and behind Riser 8 to the Valve House, as well as a mound surrounding the STP in the center riser
  - A three-inch deep “coating” was conservatively assumed across the remainder of the bottom of the tank
  - Visual inspection of primary tank indicate no saltcake remaining in Tank 9

[G-TRT-H-00513, G-TRT-H-00520, SW11.1-WTE-7.2 Rev. 161 IPC 2, SW11.1-WTE-7.2 Rev. 161 IPC 7, SW11.1-WTE-7.8 Rev. 39, SW11.1-WTE-7.8 Rev. 39 IPC 1, U-ESR-H-00241 Rev. 0]

Waste Removal Phase 3-Campaign 6



Cubic Feet 1138
Gallons 8510



[U-ESR-H-00241 Rev. 0]

Waste Removal Phase 3-Campaign 6

Support Column Seen From Center Riser

Riser 6 CSMP Seen From Riser 8

Waste Removal Phase 3-Campaign 6

Mound Behind Riser 8 to Valve House

Mound Around STP

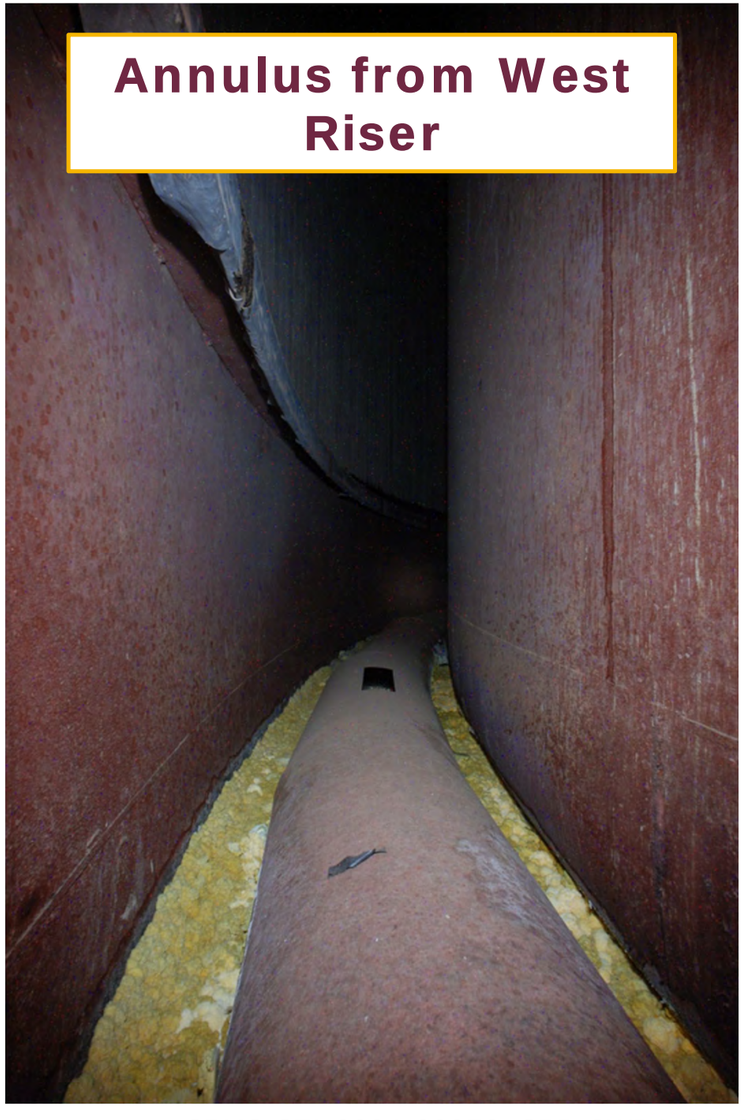
Tank 9 Annulus Cleaning

- **To reduce impacts to the overall Liquid Waste System, annulus cleaning occurred between Waste Removal Phase 3 – Campaign 6 and Campaign 7**
  - Minimized new waste added to the Liquid Waste System by utilizing liquid from the annulus cleaning process to reach liquid levels in the primary tank required to operate CSMPs
- **Tank 9 Annulus History**
  - 1955
    - *Necklace alarm indicated moisture in the annulus, however, dip tube and visual inspection showed no liquid*
  - 1957
    - *Radiation discovered in annulus exhaust duct and rate increased with time. As of October 29th, 4-5” of liquid was measured in the annulus via dip tube*
  - 1958-1959
    - *A total of nine annulus flushes were completed to return solids to Tank 9 primary*
  - 1961
    - *Leakage into the annulus resumed*
  - 1972
    - *Probings revealed a 3” layer of liquid in the annulus below a dry salt crust measuring 8-10” deep.*

[DPSPU-79-11-1]

Tank 9 Annulus State Before Cleaning

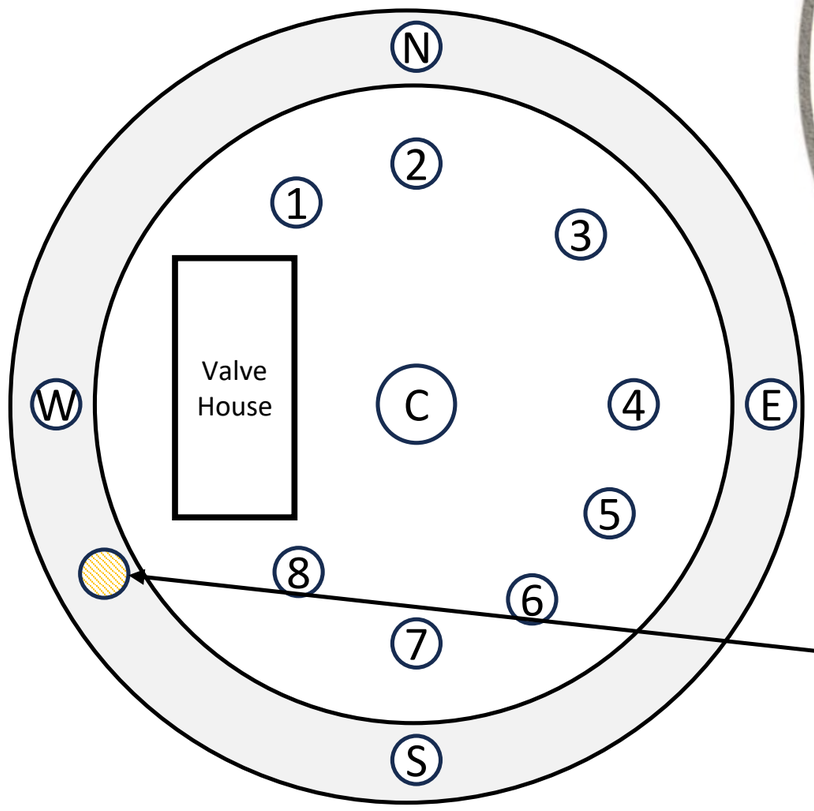
- **As of 2023 annual inspection, at least four leak sites have been identified**
- **8-10” of salt deposits in the annulus pan (3,200 – 4,000 gallons at ~400 gallons/inch)**
- **Three leak site locations are known:**
  - West – 276” from the tank bottom
  - West – 271” from the tank bottom
  - South – 269” from the tank bottom
- **The three identified leak sites are not the source of the salt deposits seen in the annulus pan**
- **At least one additional leak site must exist in an unobservable area to have created the salt deposits**

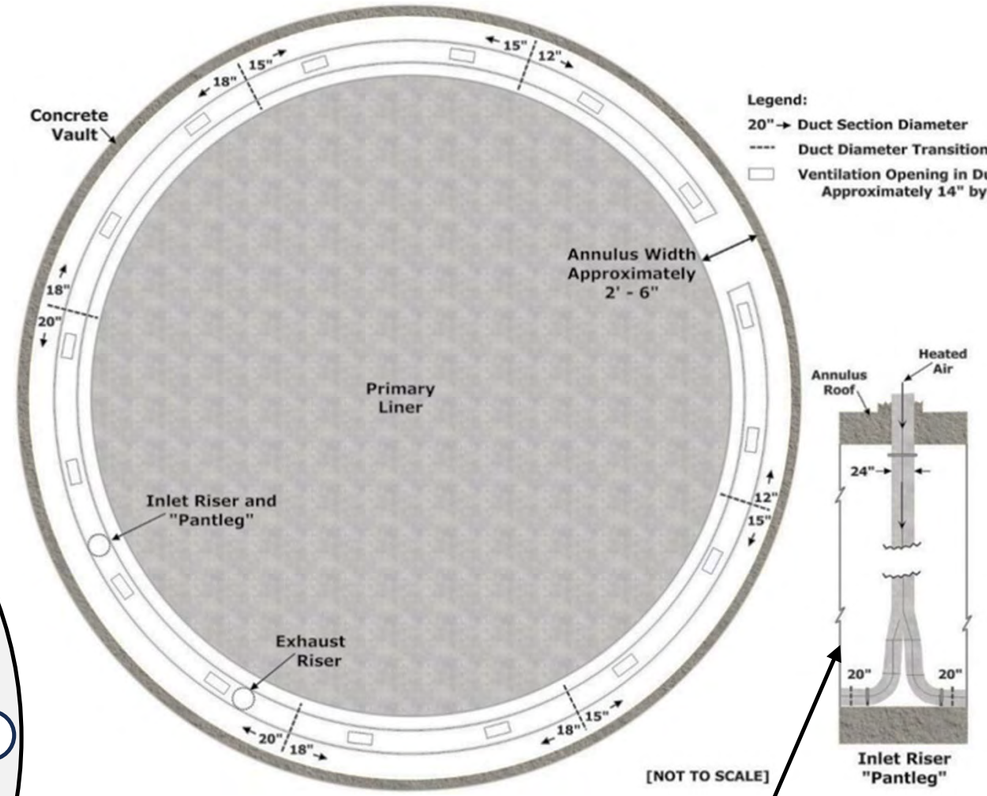


[SRMC-STI-2024-00076, SRR-CWDA-2012-00072]

Tank 9 Riser Access

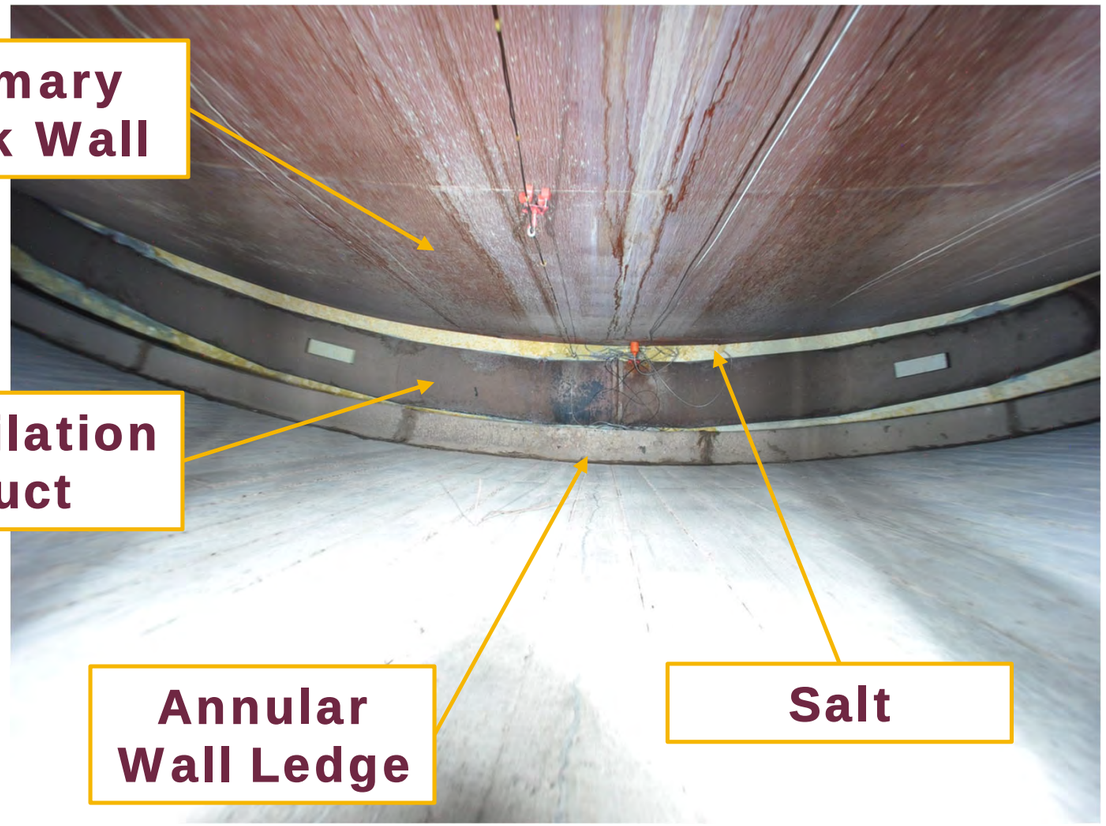
- **Primary access**
  - Eight 24-inch risers
  - One 42-inch central riser
- **Annulus access**
  - Four 24-inch risers





Tank 9 Annulus Before Cleaning

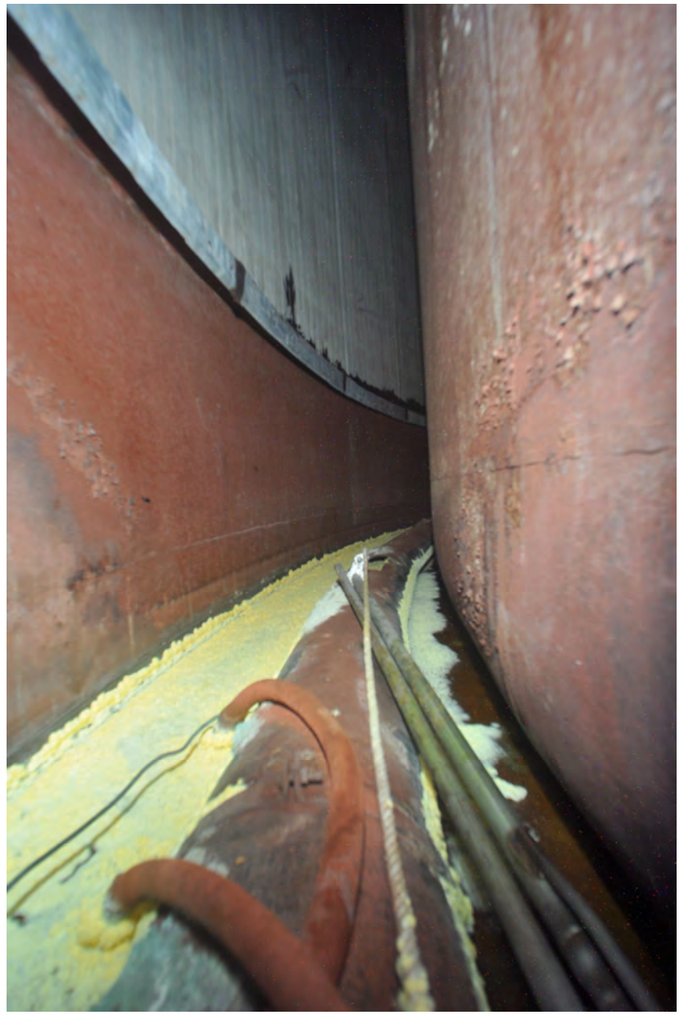
West Riser



South Riser

Tank 9 Annulus Before Cleaning

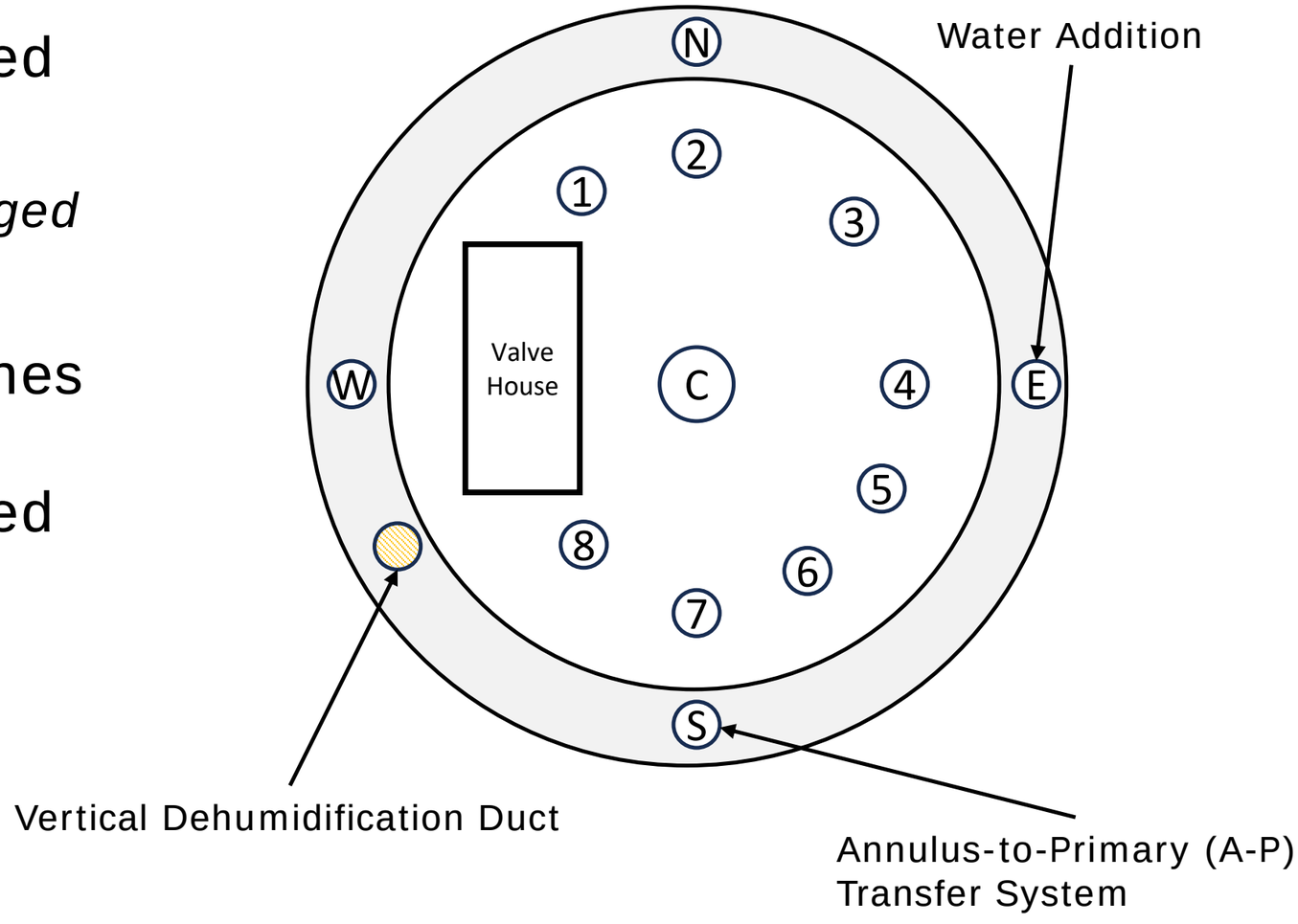
East Riser



North Riser inaccessible due to installed equipment

Annulus Cleaning

- **Batch #1**
  - 5,000 gallons of water added into the annulus via water addition downcomer
    - *Salt in annulus pan submerged*
  - 7 day soak period
  - Liquid level in the annulus after A-P transfer – 12 inches
- **Batch #2**
  - 5,000 gallons of water added into the annulus via water addition downcomer
  - 3.5 day soak period
  - Liquid level in the annulus after A-P transfer – 11 inches



Tank 9 Annulus Cleaning

West Riser Before / After

South Riser Before / After

Tank 9 Annulus Cleaning

East Riser Before / After

North Riser inaccessible due to installed equipment

- **Based on results of annulus camera inspections, annulus cleaning considered complete and Waste Removal Phase 3-Campaign 7 initiated**
- **100% annulus inspection performed after Campaign 7 to verify conditions throughout**

Waste Removal Phase 3-Campaign 7

- **A total of ~143K gallons added from multiple sources to reduce impacts to the overall Liquid Waste System**
  - ~12.5K gallons from H-Area Pump Pit 1 (HPP-1)
  - ~10K gallons DSS from the Tank 9 Annulus
  - ~3,700 gallons from H-Area Diversion Box 1 (HDB-1)
  - ~116K gallons of domestic water to bring liquid level up to a safe operating height
  - ~600 gallons of domestic water used for hydro-lancing
- **All three CSMPs were established to be at the lowest possible height in the tank, 11”**
- **The mound seen around the STP in the center riser was hydro-lanced and the STP lowered as far as possible, 1” off the bottom**
- **CSMPs in Risers 4 and 6 were indexed towards the mounds seen behind Risers 3 and 8, respectively for ~2 days**
- **All three CSMPs were operated during the transfer until the liquid level reached 35”, the minimum liquid level for safe operations**
- **Transfer of 125K gallons DSS from Tank 9 to Tank 11 completed on August 26, 2024**
  - Final liquid level ~2.6”

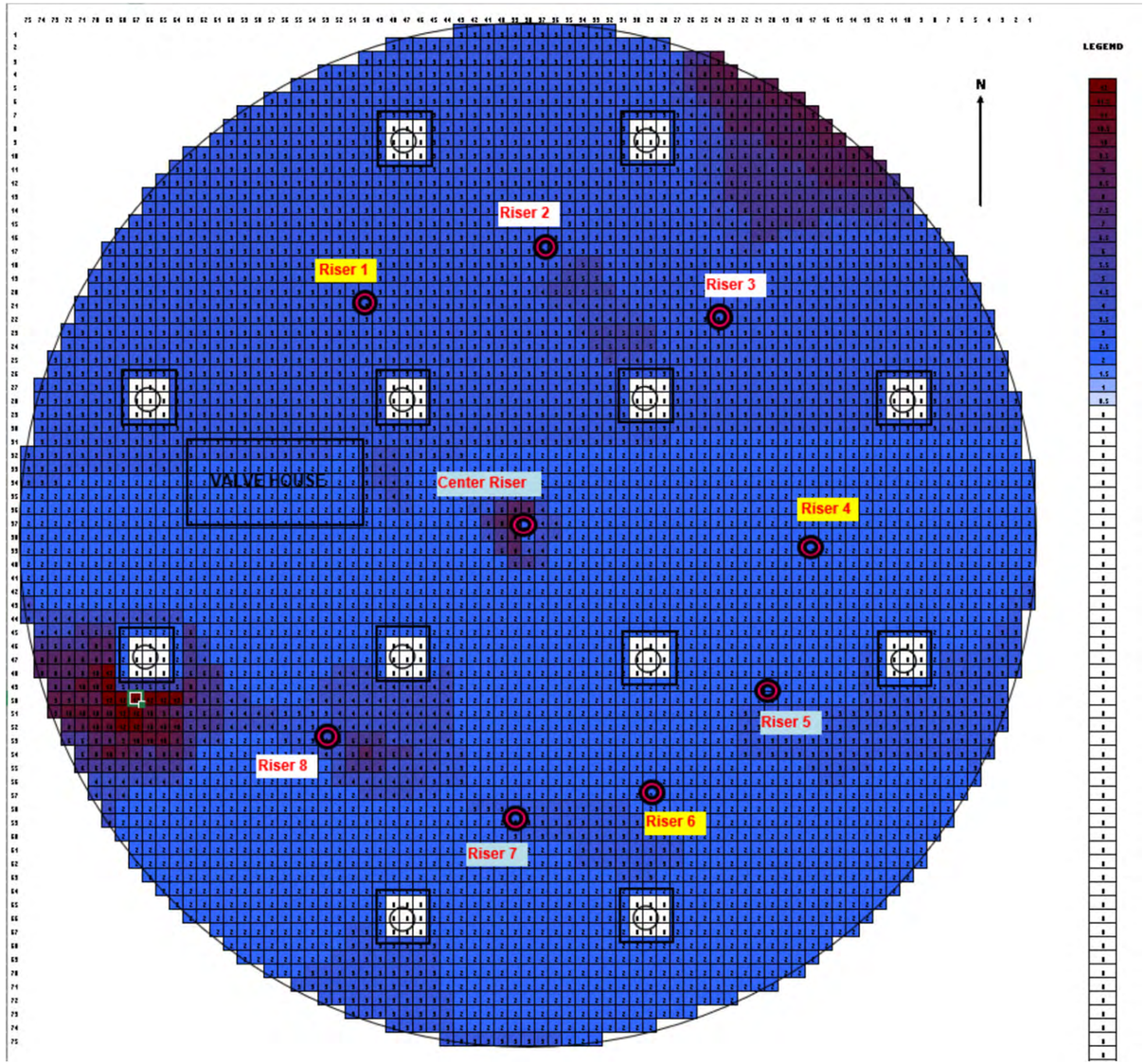
[U-ESR-H-00181 Rev. 2 Add.7, U-ESR-H-00241 Rev. 1]

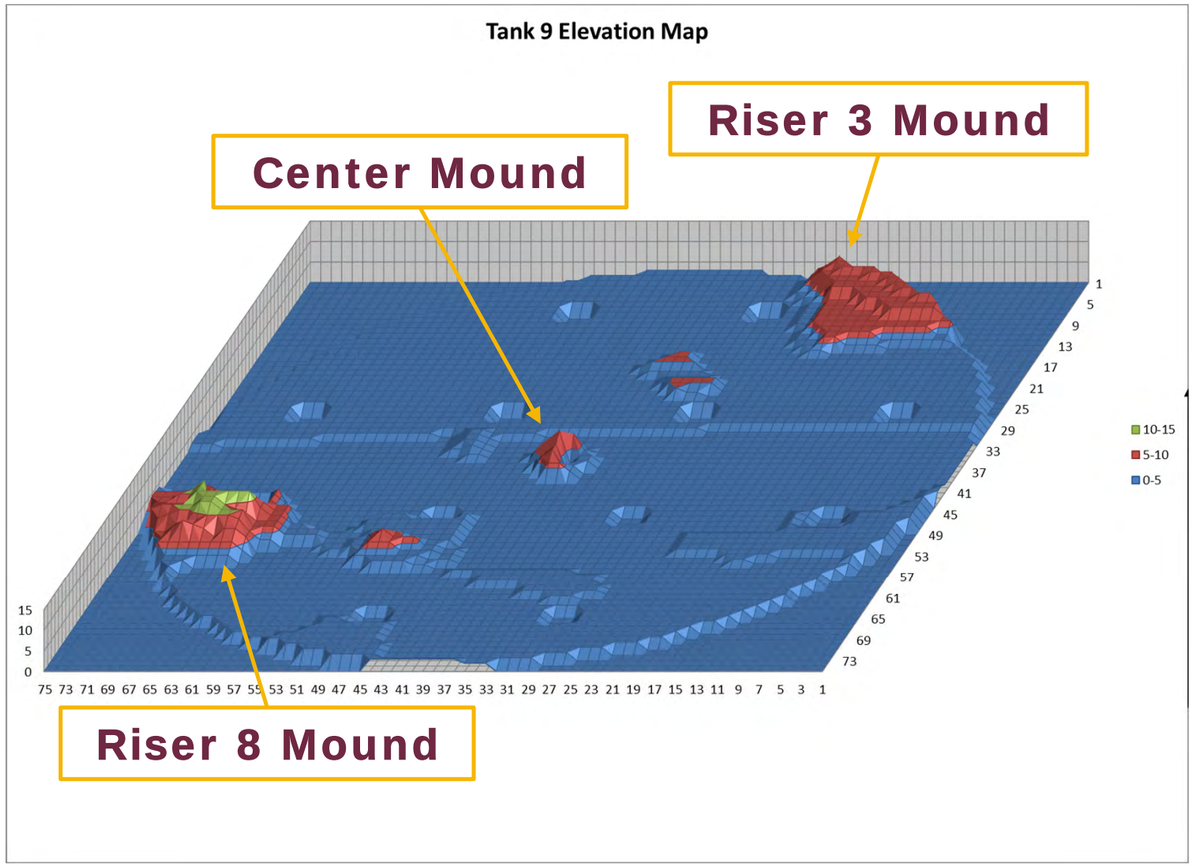
Waste Removal Phase 3-Campaign 7

- **Video inspection of the primary tank was carried out in three risers: Riser 5, Riser 7, and the Center Riser and a map of the estimated remaining solids was created**
  - Estimated <7,500 gallons of solids
  - Mounds still seen along the wall behind Riser 3 and behind Riser 8, as well as surrounding the STP in the center riser, however the material had shifted
  - A two-inch “coating” was conservatively assumed across the bottom of the tank

[U-ESR-H-00241 Rev. 1]

Current Status of Tank 9





[U-ESR-H-00241 Rev. 1]

Current Status of Tank 9 – From Riser 7

Below Riser 7

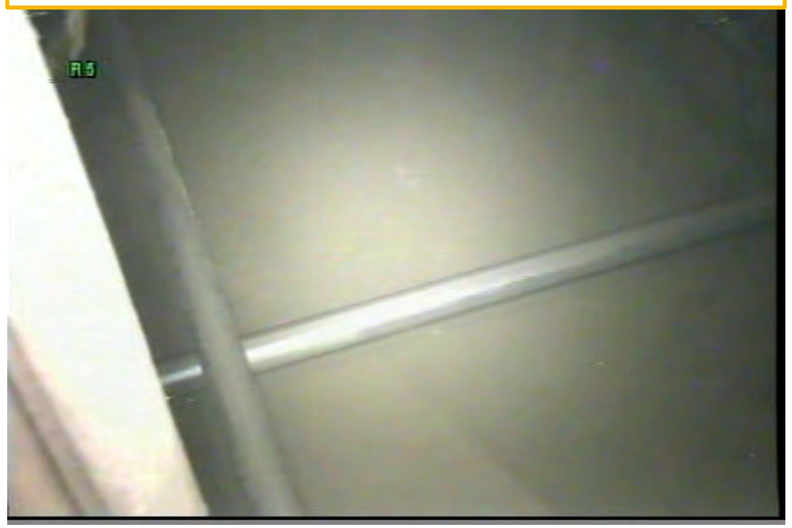
Riser 7 to Southern Wall

Riser 7 to Southwestern Wall

Riser 7 to East

Current Status of Tank 9 – From Riser 5

Below Riser 5



Riser 5 to Southeastern Wall

Riser 5 to Southwest and Riser 6

Riser 7 to Northeast and Riser 4

Current Status of Tank 9 – From Center Riser

Floor Between Center Riser and Northeast Support Column

Center Riser to East

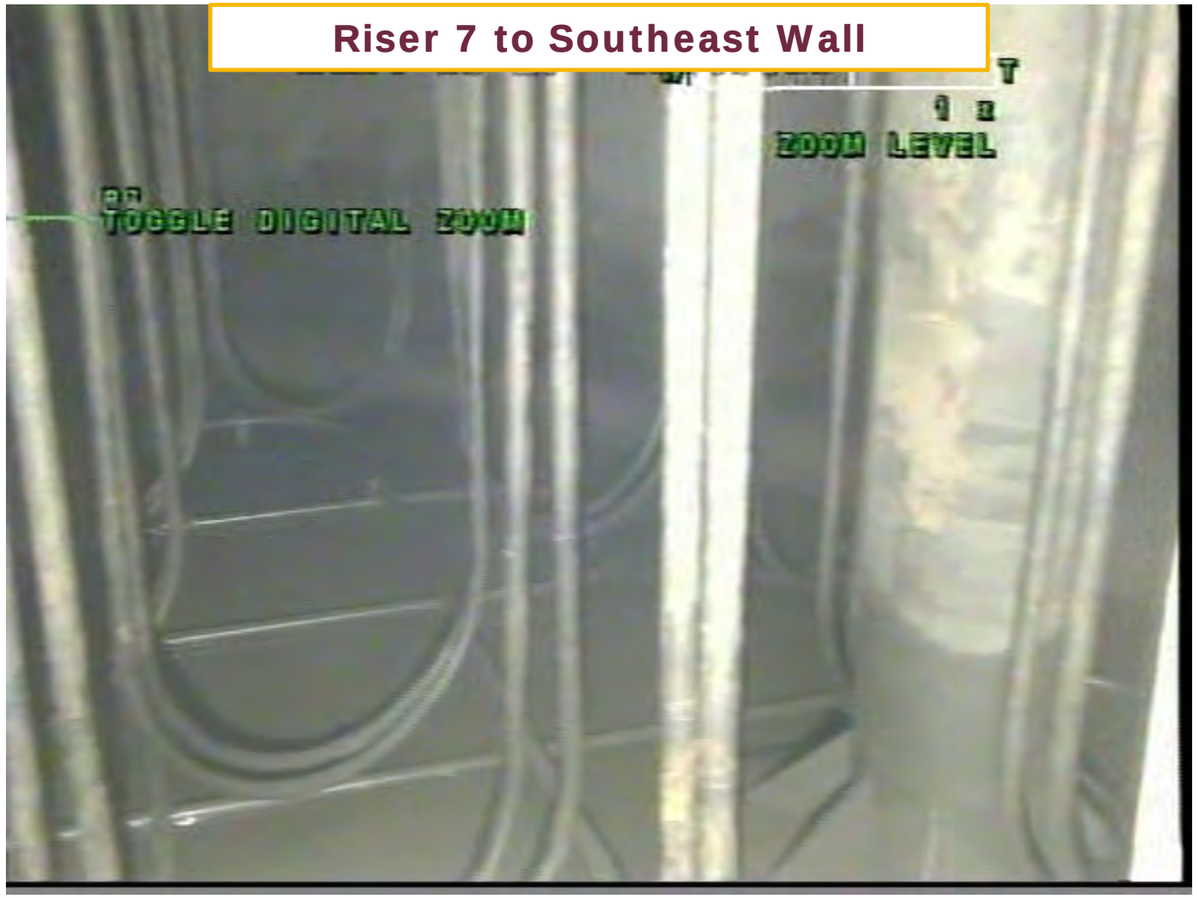
Center Riser to Southeast

Center Riser to West

Current Status of Tank 9 – Walls

Riser 7 to Southwest Wall

Riser 7 to Southeast Wall



Current Status of Tank 9 – Center Mound

Current Status of Tank 9 – Riser 8 Mound

By Column Base Plate from Center Riser

Close-up of Southern Side from Riser 7

Southern Side from Riser 7

Eastern Side from Center Riser

Current Status of Tank 9 – Riser 3 Mound

From Center Riser

Southern Side from Center Riser

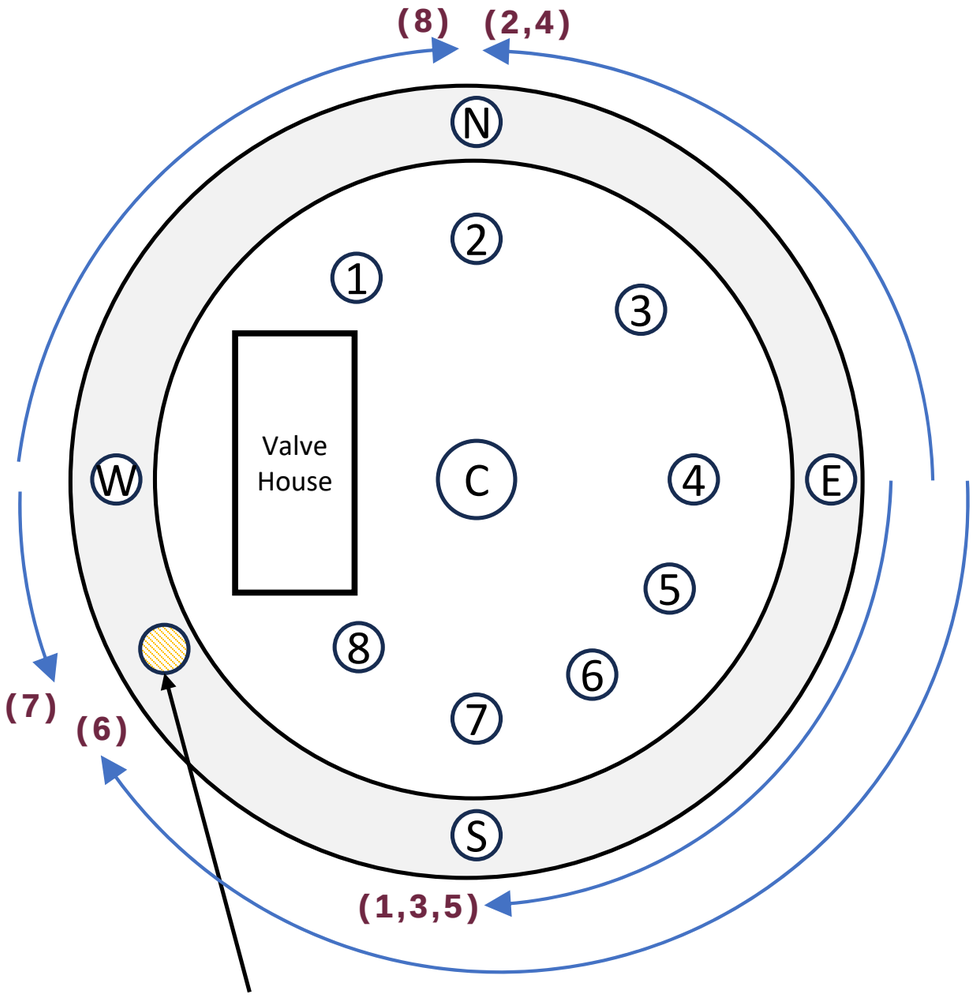
Southern Side from Center Riser

By Column Base Plate from Center Riser

Annulus Inspection

- **After Campaign 7, the annulus was inspected utilizing a drone**
  - First use of this technology within the tank closure process
  - Introduced during the Annual Technology Briefing provided November 2023 during the 4QFY2023 Liquid Waste Quarterly Regulatory Meeting

Drone Inspection



Vertical Dehumidification Duct

- **After initial flights establishing drone capabilities the drone was flown along dedicated flight paths to document any remaining salt in the annulus**
  - (1) Entered through the East Riser and flew along the midline of the tank to the South Annulus Riser looking for salt nodules
  - (2) Entered through the East Riser and flew along the middle weld of the primary tank toward the North Riser
  - (3) Entered through the East Riser, flew near the annular pan ledge to the South Riser, inspecting the annulus floor for salt
  - (4) Entered through the East Riser flew towards the North Riser along the annular pan ledge, focusing on the bottom of the annulus pan
  - (5) Entered the East Riser and again flew south along the annular pan ledge, inspecting the annulus floor for salt
  - (6) Entered the East Riser and flew south, passing the South Riser and continuing to the Vertical Dehumidification Duct inspecting both the primary tank wall and the bottom of the annulus pan
  - (7) Entered through the West Riser and flew south to the Vertical Dehumidification Duct inspecting both the primary tank wall and the bottom of the annulus pan
  - (8) Entered through the West Riser and flew north to the North Riser inspecting both the primary tank wall and the bottom of the annulus pan

Tank 9 Annulus Cleaning

East Riser

Southeast Quadrant

Tank 9 Annulus Cleaning

South Riser

West Riser

Tank 9 Annulus Cleaning

Dehumidification Duct South Side

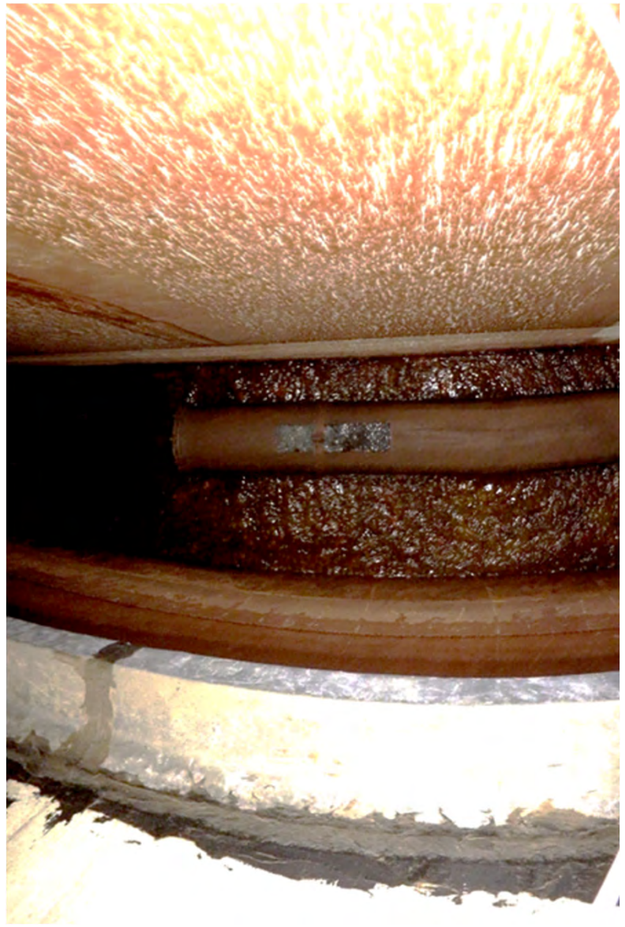
Dehumidification Duct West Side

Northwest Quadrant

Tank 9 Annulus Cleaning

North Riser

Northeast Quadrant



Tank 9 Annulus Cleaning

- With the drone, 100% inspection of the Tank 9 annulus was possible
- Inspection of annular pan showed cleaning effectiveness consistent in all areas
- No salt accumulations were seen on either the exterior walls of the primary tank or in the annular pan

Summary for Closed/PCWR Complete Tanks

Waste Tank	PCWR Date	Max. Dose within 10,000 years[1] (mrem/year)	Primary Tank Residual Solids Volume (%)[2]	Primary Tank Residual Solids Volume (Gallons)	Annulus Residual Volume (Gallons)	Annulus Cleaning
5	11/2010	3	0.26	1,900	<15	No – negligible
6	11/2010	3	0.41	3,000	<50	Yes ~100 gal.
10[3]	5/2024	<2	<0.40	<3,000	<400	Yes
12	1/2014	6	0.20	1,500	30	No – negligible
16	4/2013	2	0.21	356	1,910	No – not practical
17	Closed 1997	3	0.18	2,400	N/A	N/A
18	10/2009	3	0.30	3,900	N/A	N/A
19	10/2009	3	0.15	2,000	N/A	N/A
20	Closed 1997	3	0.08	1,000	N/A	N/A

[1] Dose for FTF tanks represents maximum all sources dose utilizing actual inventories for Tanks 5, 6 and 17-20. Dose for HTF tanks represents maximum contribution from individual tanks. [SRR-CWDA-2012-00106, SRR-CWDA-2015-00073, SRR-CWDA-2014-00106]
[2] Based on historic maximum waste volume for each tank. [DOE/SRS-WD-2012-001, DOE/SRS-WD-2014-001]
[3] Tank 10 Values based on preliminary information

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